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MODEL Airplane NEWS

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Reviewed

- Hangar 9 Advance 40 VRTF
- Thunder Tiger Raptor .30 Heli
- Bob Violett Models turbine-powered MiG 15

MODEL Airplane NEWS

FOUNDED 1929

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MAIN COVER IMAGE: down on the deck for a beautiful photo pass, Kristen Leu's DynaFlite PT-19 flashes by. Kristen's model flew several times at the 2nd Annual World Minature Warbird Classic in Kirkwood, NY (photo by Gerry Yarrish). Top inset: NASA's R/C test model of the new X-33 reentry vehicle touches down after a successful "drop test." The X-33 may someday replace the aging space shuttle. Lower inset: designer Rich Uravitch holds his newest creation, the DR-109: a two-place "One Design." See the plans on page 51.

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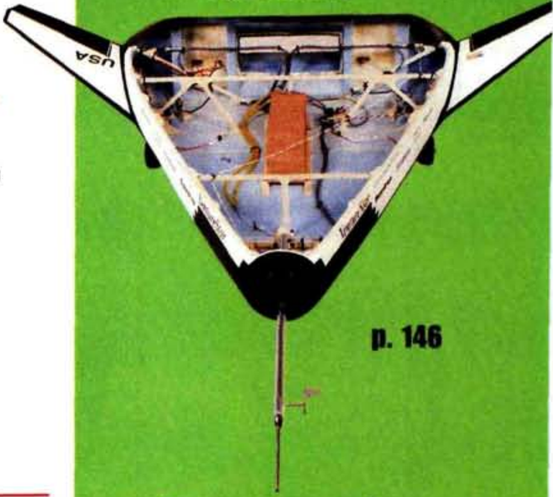
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Departments

On a Growth Curve

There is an amazing story to be told of recent technological progress in sport planes, jets and in giant scale. The trend toward larger glow and gas engines in evidence at recent trade shows has been paralleled by the development of ever more sophisticated onboard ignition systems. Some of these systems permit the modeler to convert an engine from glow fuel to gas, so available options now include choice of fuel. Curious about the pros and cons of switching your 2-stroke glow engine to gasoline propulsion? See "Run your SuperTigre G.90 on gasoline," page 76.

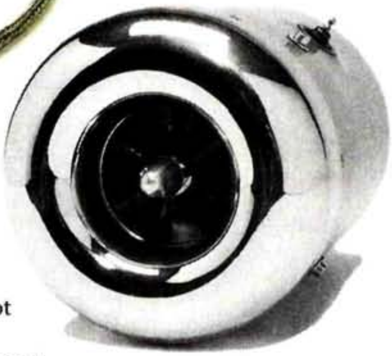
Digital servos that have just arrived on the scene offer unprecedented precision, speed and torque. Piezo gyros continue to grow lighter, smaller and more accurate. As remarkable as these ongoing developments are, consider also that turbine fan jets now typically comprise at least half the entries at a few of the major jet events! For a closer look at one of these state-of-the-art turbine-powered aircraft, see our "Field & Bench" review of the Bob Violett Models MiG 15 on page 36. In that article, you'll also see details on the RAM 750F turbine engine, one of several now certified by the AMA for use in radio-control modeling.

Speaking of jets, we are proud to announce that *Model Airplane News* will be the primary sponsor of a major jet event—Florida Jets—to be held on March 2 through 5, 2000, at the Flagler County Airport near Bunnell, FL. Check out our recent coverage of that event in the July issue of *Model Airplane News* to get a feel for the growing importance of turbines. For more information on the upcoming Florida Jets, contact promoter Frank Tiano at (561) 795-6600; fax 795-6677, or email him at ftiano@aol.com.

DESIGNS FOR WINNING

We offer two construction articles in this issue that represent "the best of the breed" in their respective categories. Long-standing contributor and accomplished designer Rich Uravitch offers a scale DR-109, an updated ⅕-scale "One Design" that faithfully embodies the best qualities of the original DR-107 in its new, two-pilot, slightly stretched configuration. Based on plans provided to Rich by Dan Rihn, the designer of the full-scale aircraft, this plane has increased length and span and smoother flying qualities. It is a natural for MINIMAC and sport-scale competition, and because it is an aerobatic thoroughbred, it's also guaranteed fun (see page 48).

Bob Aberle, also a highly respected model designer, offers us the PRO-POD, a competition airplane for an emerging class known as "½A electric competition." Using an inexpensive Speed 400 motor and 7-cell battery pack, this airplane is designed for competition that allows a 90-second motor run, an 8-minute total flight and a spot landing.



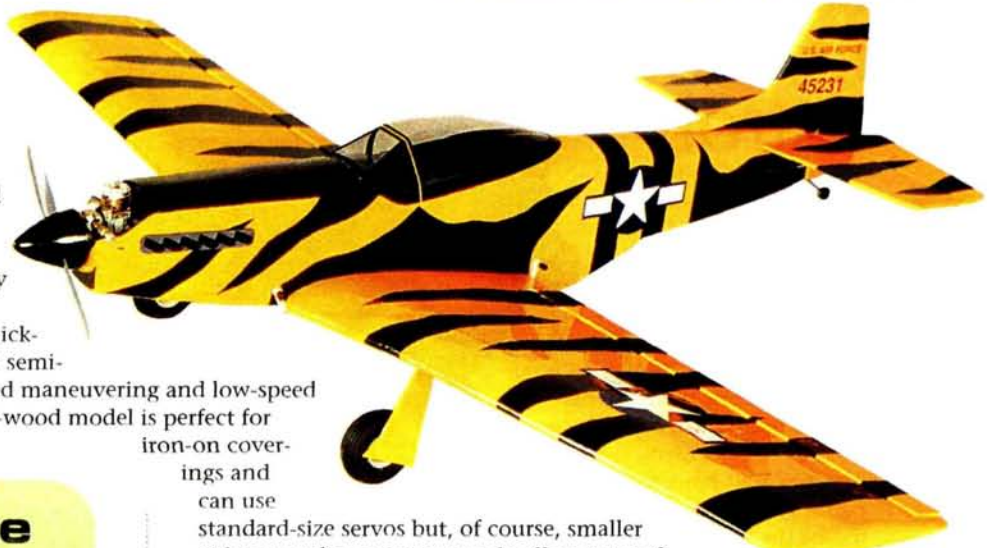
Whether you want the edge in aerobatics or precision electric competition, these planes give you what you need without making serious dents in your pocketbook.

We'd like to thank those who have responded to our request for feedback. In addition to following leading product and technology advances from micro to giant scale and across all R/C aeromodeling categories, we will be offering more product guides and performance evaluations. Is there a particular category of product you would like to see surveyed in our pages? Write to us at *Model Airplane News*, Air Age Inc., 100 East Ridge, Ridgefield, CT 06877-4606 USA; fax (203) 431-3000; or email us at man@airage.com.

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will at times cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

AIR SCOOP

BY CHRIS CHIANELLI



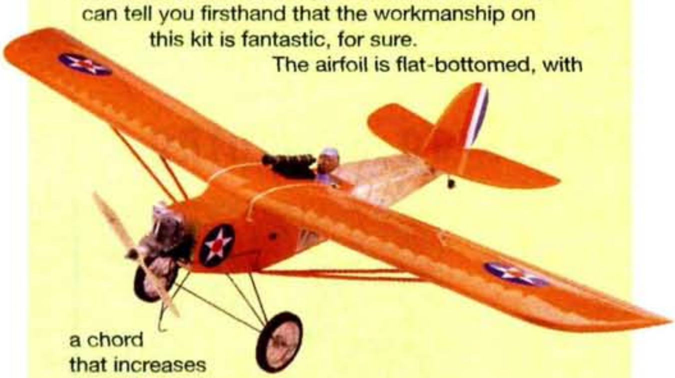
FULL-HOUSE Mini Mustang

Herr Engineering has been making quite a name for itself with the super-high-quality, 4-channel small kits it offers. I know many of you will be happy to see this "full-house" mini Mustang join the Herr line. This quick-building Herr P-51 features a computer-designed semi-symmetrical airfoil that excels in both high-speed maneuvering and low-speed stability, according to the manufacturer. This all-wood model is perfect for iron-on coverings and can use standard-size servos but, of course, smaller airborne radio components do allow a significant weight saving. Specs: wingspan—42 inches; wing area—303 square inches; weight—22 ounces; wing loading—10.4 ounces per square foot; engine—.049 to .074.

Herr Engineering Corp., 1431 Chaffee Dr., Ste. 3, Titusville, FL 32780; (407) 264-2488; fax (407) 264-4230.

You Wanna have Fun?

If you're looking for fun—and who isn't?—Global's new Blue Max ARF will deliver. This ultra stable WW I, 1920s-style sport plane is 90-percent finished and covered in super-visible transparent orange. Easy to see through that bright orange is the tail-boom truss work that gives the Blue Max that awesome vintage appeal we love. I was recently out at Global's secret development warehouse, and I can tell you firsthand that the workmanship on this kit is fantastic, for sure.



The airfoil is flat-bottomed, with a chord that increases toward the tip. I predict that this model will be very aerobatic with the appropriate control-surface throws, yet virtually stall-proof; perfect for close-in barnstorming. The kit includes a "whacked-out," beret-wearing pilot and pirate's cannon and will probably sell for under $190. Oh, yes; that includes a set of handmade, 5-inch, metal-spoke wheels like those seen here on the model. Did you ever price these separately? We're talking $40 or $50, at the very least. Specs: wingspan—67.25 inches; wing area—756 square inches; weight—approximately 5.5 pounds; wing loading—approximately 16.8 ounces per square foot; engine—.40 to .60 2-stroke, or .52 to .70 4-stroke; radio required—4-channel.

I've got to have one of these; it's a perfect remedy for a day filled with annoying people. Besides, Snoopy will be so jealous!

Global Hobby Distributors, 18480 Bandilier Cir., Fountain Valley, CA 92728-8610; (714) 964-0827; fax (714) 962-6452.

Magnum XL-1.20 RFS

Word has it from my flightline spies that Magnum 4-strokes are doing a good job out there supplying modelers with a weekend's worth of dependable flying. Now, a new 1.20 has joined the Magnum line: like the others, the 1.20 uses the latest CNC machines for consistent high quality.

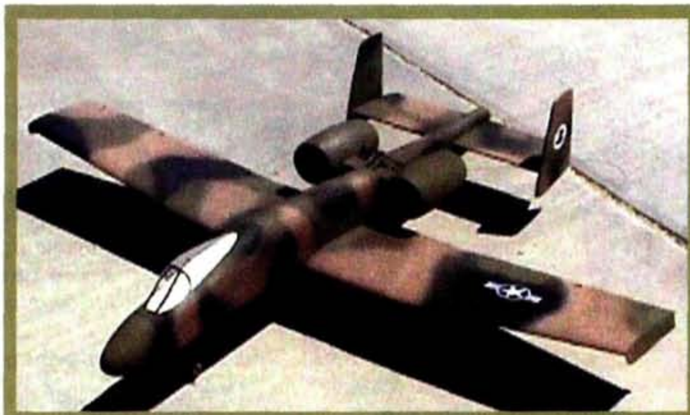
The 1.20 RFS features twin-needle carb, ringed-piston technology and blowby gas recirculation for crankcase ventilation and cleaner running. Here's the best part: this 1.20 sells for $240—a lot less than other sport 1.20 4-strokes, and I'm hearing that its performance is quite comparable to higher-priced engines. We'll test this one soon.

Global Hobby Distributors, 18480 Bandilier Cir., Fountain Valley, CA 92728-8610; (714) 964-0827; fax (714) 962-6452.

Backyard Dawn Patrol

You knew it had to happen, didn't you? If you didn't know, you must be asleep at the switch. It's Hobby Lobby's ready-built Fokker Dr.I Triplane Slowflyer. Like others in the WW I Slowflyer series, the Fokker is very easy to assemble (it takes about 5 hours); it's constructed of high-quality, prefabricated hard foam and precision die-cut wooden parts. The fuselage and tail group are prepainted. "Slowflyer" means the triplane flies right in front of your face at incredibly slow speeds, yet is extremely maneuverable. Specs: wingspan—28 inches; wing area—310 square inches; weight: approximately 10 ounces fully equipped; wing loading—4.7 ounces per square foot.

Hobby Lobby Intl., 5614 Franklin Pike Cir., Brentwood, TN 37027; (615) 373-1444; fax (615) 377-6948.



A10 FROM ELECTRIC JET

In my Toledo show coverage a few months back, I told you about an exciting company called Electric Jet Factory. In that coverage, I highlighted an ARF, electric ducted-fan A7 Corsair, and I said I was going to watch this company because there was more to come from what they call their "Flying Styro Line." Well, here it is: a twin, electric, ducted-fan Warthog. What do you think? I think it's totally cool. Like the A7, the A10 is a prefinished, electric, ducted-fan-powered foam scale jet. The Warthog's wingspan is 40 inches, and it uses two EDF 400 (Speed 400-size) fan units. Rumor has it that the A10 recently received best "e" jet award at a recent jet rally.

Electric Jet Factory; distributed by Animated Objects Inc., 8929 N. Ferber Ct., Tucson, AZ 85742; (520) 579-5609; fax (520) 579-5610.

Onboard insurance

Some of the crashes I've experienced over my R/C'ing years—and there have been many—were the direct result of an engine quitting and being unable to make it back to the landing strip.

Hazards abound in the outer reaches of a flying field; I've hit everything from a rotten tree stump to a rusted-out '61 Buick Delta 88 ... or was it an Olds? Who cares? Either one will totally destroy an R/C airplane if encountered while gliding at landing speed.

Not only will Horizon Hobby's Expert's On-Board Digital Glow Driver make your engine idle as never before, but it's also insurance against "flameouts"; a great investment for protecting your much-loved model. Using either computer mixing or a Y-harness, simply plug the unit into your throttle channel and set it to activate when the throttle stick moves below a chosen position. Powered by a 4.8V, 600mAh pack, the charge will last about an hour, depending on which glow plug you use.

A 6V pack is recommended for multi-cylinders; plus, for the weight-conscious, a single 1.2V cell may be used. At only 1.4 ounces and 2¼x1⁷⁄₁₆x⁵⁄₁₆ inches, the Expert's Glow Driver can be installed in even smaller models.

Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61822; (217) 355-9511.

One-Stop Shopping

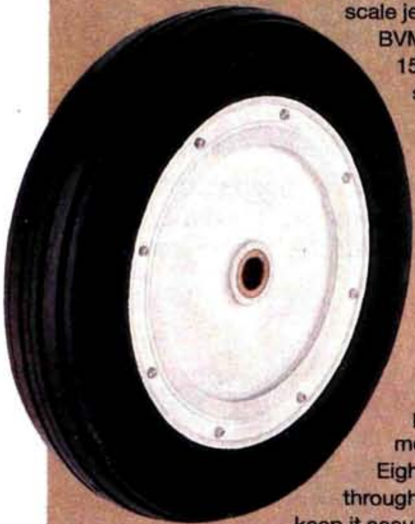
It used to be that when you got started in our great hobby, you made one trip to the hobby shop to pick out an airplane and then made 14 more trips to get the support stuff you needed to go flying; not anymore, though, thanks to Horizon Hobby Distributors' SkyPack Pilot Support Package. In one convenient box, the SkyPack contains everything you'll need to get off the ground. You get JR's precision F400EX radio-control system with four S517 servos, a quart of Hangar 9 AeroBlend Fuel, a powerful MDS .40 FS Pro engine and Du-Bro's Kwik-Klip Ni-Cd glow driver. In addition, the SkyPack includes a durable cardboard field box in which you can carry your accessories to and from the flying field, a Hangar 9 Manual Fuel Pump with tubing, a 4-way socket wrench and even a safety stick for prop-starting your engine. The Hangar 9 SkyPack takes the hassle out of finishing your kit and gets you to the flying field—and into the air—quickly and easily, and it's only $299.95.

Hangar 9; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61822; (217) 355-9511.

4-inch Brake

FROM VIOLETT

A 4-inch-diameter, narrow-profile brake/wheel now joins Bob Violett's super-precise line of jet wheels and brakes. This new, narrow-profile design is perfect for 1/8-scale jets such as BVM's new MiG 15 and the soon-to-be-available F-86. The wheel is built to withstand the stresses imposed by high-speed, turbine-powered model aircraft. Eight bolts pass through the tire to keep it secure on the rim even at very high ground speeds.



Of course, this new wheel uses the patented O-ring brake—the simplest and most effective system available. An all-new, proportional braking valve dubbed the "Smooth Stop" will soon be available for all 12 sizes of BVM wheels.

BVM, 170 State Rd. 419, Winter Springs, FL 32708; (407) 327-6333; fax (407) 327-5020.

Great Planes Helps you get Organized

I don't know about you, but somewhere along the way in a building project, my bench top goes from a freshly vacuumed, pristine work surface to Yucca Flats after the blast. I don't know why; maybe it's because I build and watch "Star Trek" at the same time, and I unconsciously toss my tools anywhere when I've finished with them. A workbench that's cluttered with building "stuff" not only makes it difficult to find a much-needed tool at a crucial moment, but obstacles such as runaway screwdrivers, hidden bolts and spilled glue can also alter a freshly finished fuselage for the worse.

To help with workshop organization, Great Planes has introduced two handy organizers that I, for one, must have: the prebuilt Benchtopper and Glue Caddy. Just like the original Benchtopper, the prebuilt and painted Benchtopper keeps building tools and accessories together in one safe, handy location, so you'll know right where everything is at all times. This unit features wooden construction, epoxy/mixing-cup holders, tool/knife holders, two small drawers, one big drawer, a deep tool well, a CA shelf, T-pin storage shelf and a hobby-blade disposal slot, and it may be mounted on a wall. If—like me—you were too lazy to build a Benchtopper, you now have no excuse.

Next up is the Glue Caddy. This handy little unit is designed to hold an epoxy set, two 1-ounce bottles of CA, accelerator, epoxy cups, mixing sticks and epoxy brush in one compact area. Like the Benchtopper, the Glue Caddy comes completely assembled and finished. I see this little organizer being just as handy at the flying field; it will fit easily into many flight boxes.

Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826; (217) 398-6300; fax (217) 398-0008.

Electric Power Arrives

I thought you guys would like to take a quick look at the new line of mini warbirds from Electric Power Products. I can't tell you too much yet, but these ARF, prefinished hard-foam models are powered by gear-reduction Speed 280 motor units. As far as I know, the line includes the F4-U Corsair and P-51 pictured here. I'll keep you posted on developments. If you just can't wait for the next issue, contact the company.

Electric Power Products; distributed by Animated Objects Inc., 8929 N. Ferber Ct., Tucson, AZ 85742; (520) 579-5609; fax (520) 579-5610.

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," MODEL AIRPLANE NEWS, 100 East Ridge, Ridgefield, CT 06877-4606 USA; email man@airage.com. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we can not respond to every one.

STOP THAT YAW

I have been building models for a while now and regularly fly sport models. I am now flying a scratch-built Super Cub with flaps, but I'm having a problem with adverse yaw. I do not have a computer radio so I cannot program differential into my ailerons. What can I do?

GEORGE UNGER
Bremen, Germany

George, you can do a couple of things to prevent the nose of your model from swinging in the wrong direction when you turn your Super Cub. First, apply both aileron and rudder input to coordinate your turns. Some models even require that you lead (start) the turn completely with rudder input and add in the ailerons afterward; my Ziroli Stearman PT-17 is a good example of this.

Anyway, to add differential throw to your aileron system without a computer radio, you can—using one centrally located servo and 90-degree bellcranks—move the aileron control horns forward of the aileron hinge line (if they are on the bottom of the control surface). This will cause more upward aileron movement and less downward movement by increasing the servo's "push" direction of travel aft of the hinge line. The same thing can be done with two servos (one in front of each aileron) and a Y-harness connecting them. In this case, you would move the pushrod/servo wheel connection forward of the servo's neutral position. By moving the pushrod relative to the center of the servo's travel range, you effectively increase one side's travel and decrease the other side's travel. The result of this is less unwanted yaw and smoother turns. GY

TORQUE TALK

I am building an open-bay floater glider with a wingspan of 86 inches, and the two aileron servo bays allow for a servo width of no more than ½ inch. A variety of specialized servos is available, but I am looking for something that is affordable, has sufficient torque and will fit in the small servo-bay area; my standard servos are much too large. Could you offer any tips regarding which servo I should use?

LEONARD KLEIN
Phoenix, AZ

A variety of new, miniature servos has recently become available, and some have surprising torque for their tiny size. Using one of these with the proper-size servo arm will minimize weight and get the job done. A good choice for actuating your ailerons would be the new JR 241 sub-microservos. These have 17 oz.-in. of torque, which is adequate for an 86-inch-span glider in the floater category. For years, single servos with an output torque of about 45 oz.-in. have been used to actuate two ailerons in trainers and sport planes, so using two 17 oz.-in. servos on your glider will work well. The JR 241s weigh only .32 ounce. Because they measure only .45x.87x.85 inch, they will easily fit in your aileron bays. Moreover, unlike some other brands of sub-microservos, their standard packaging includes output arms of various lengths. This servo also has an affordable list price: $29.95. TA

ENGINE OUT

Lately, every time I fly my R/C trainer, its .40FP quits about halfway through the flight. *Help!* I'm quickly becoming an expert "glider" pilot. What can I do to prevent this?

MATT McFADDEN
Newtown, CT

There are several things to check, but first, how old is your fuel? If it has been sitting around for a couple of years in a previously opened bottle, the nitromethane has probably evaporated. This will definitely cause the problem you're having. You'll have to buy some new fuel.

Other considerations are the temperature, barometric pressure and the elevation of your field. Say you fly on a day that has a moderate temperature (in the 70- to low 80-degree range) and a higher than standard barometric pressure (above 29.92 inches of Hg), at an elevation of 700 feet. If you send the airplane up with too lean a setting, i.e., the engine is screaming with max rpm, there is probably too much air in the atmosphere, and it will dominate the fuel/air mixture to the carburetor. Plenty of air but very little fuel will make the engine lean out, run extremely hot and eventually quit. Is the engine too hot to touch after the landing? If so, send the plane up with a richer setting—back the needle valve out counterclockwise ¼ turn. A good ground check for the needle-valve setting is the nose-up/nose-down test.

With this method, you set your needle valve to the desired rpm; at full throttle, hold the nose of the model up in the air at a 45-degree angle (make sure that the prop arc is not in line with your face or anyone on the ground), and then point the nose down to the same angle. When you pick up the nose, the rpm should increase; when you point the nose down, the rpm should decrease slightly. The next check is to see where the idle mixture is set. With the airplane on the ground, let the engine idle for a few seconds and then—while holding onto it firmly—gun the throttle to the max position. Does it go to full blast without hesitating? If it "wallows" and eventually goes, it is too rich; if it quits as soon as you push the stick, it is too lean. Refer to your engine's manual about how to adjust the idle setting. If you are in the beginning stages and are flying your plane with a throttle setting of ½ or lower, and the idle setting is too lean, it will cause the engine to quit after a certain length of running time.

Make sure that your fuel tank is properly aligned with the carburetor intake and that the clunk inside the tank moves around freely to all four corners of the tank. Sometimes, on a hard landing, the clunk will fall forward and stay there, creating a bend in the line. If you have had such a landing, grab the airplane by the stopped propeller and the bottom of the fuselage and shake it up and down vertically to get the clunk to return to its normal position.

Check the glow plug. Sometimes, not all the coils ignite, so the engine runs for a short while and then stops. Make sure that nothing is blocking the muffler's exhaust outlet. This will lead to a backup in the exhaust system that will overheat the engine and cause it to quit.

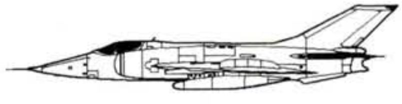
I hope this helps. RP

HINGING ON A BET

First, I want to thank you for all the helpful "how-to" articles that appear in the magazine every month; keep up the good work! Maybe you can solve a small difference of opinion I've been having with a friend. On my new fun-fly plane, the rudder hinge line is angled backward at about a 20-degree angle. Does the control horn go perpendicular to the hinge line, the way my buddy says, or parallel to the fuselage? There's a pizza riding on your answer, so please let us know. [email]

DAN HANSEN

Dan, thanks for the kind words. As far as the control horn is concerned, you always want it to follow the direction of flight; it need not necessarily be parallel to the fuselage. While this isn't the ideal setup, under the circumstances, it provides maximum authority over the control surface and minimizes binding. Even though you were closer with your answer, I'm afraid you'll have to send us the pizza—bacon and onion, please. BH



PILOT PROJECTS

A look at what our readers are doing

R/C RETIREE

A. Webster Tenney Jr. of Arlington, TX, took up R/C flying after retiring about a year ago. This gorgeous Top Flight F4U-5 Gold Edition is his first scale effort. The 62-inch-span gull-wing plane has an O.S. .61FX for power. With his new-found free time, Webster detailed the Corsair just like one he saw in a Squadron/Signal book with a 4-blade prop, eight rockets, an antenna mast and wingtip lights. We hope his retirement is going well, and we look forward to Webster's next contribution.

A LITTLE EXTRA

Using a set of *Model Airplane News* plans, Steve Aldridge of Boise, ID, built this Extra 3.25 with foamboard ribs and fuselage formers. Steve glassed the fuselage with .56-ounce cloth and Finish Cure epoxy, then sprayed it with 21st Century primer and topped it off with Cub Yellow dope. The wing is covered in MonoKote, and the black trim is Rustoleum paint. The O.S. .25FP-powered airplane is "very solid and stable in flight, yet very aerobatic," writes Steve.

ROSS'S REDMOND RYAN

With airplanes like this stunning Ryan STA, it's no wonder that the Redmond, OR, R/C club is known as the "Field of Dreams." This faithful replica of a scale Curtiss, built by Ross Schmerse, is powered by an O.S. .61 FX and flawlessly finished with Ultracote Plus. Look at that scenery … just like your flying field, right?

SEND IN YOUR SNAPSHOTS. ***Model Airplane News*** **is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable. We receive so many photographs that we are unable to return them.**

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of the year. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA.

LEAR-Y IN LINDENWOLD

Your flying buddies always ask for favors—a glow plug here, a prop there—but this takes the cake: when Tom Owens of Lindenwold, NJ, decided his next project would be a Great Planes Lear Jet, his friend Tony Verchio told him, "You better build two; I want one." Tom listened! The pair of jets is attractively trimmed in MonoKote and powered by SuperTigre .61s, and they carry Futaba radio gear. We're told Tom's jet (no. 1) flies great but that Tony wants to admire his a little longer before it takes off.

AUSSIE ANTIQUE

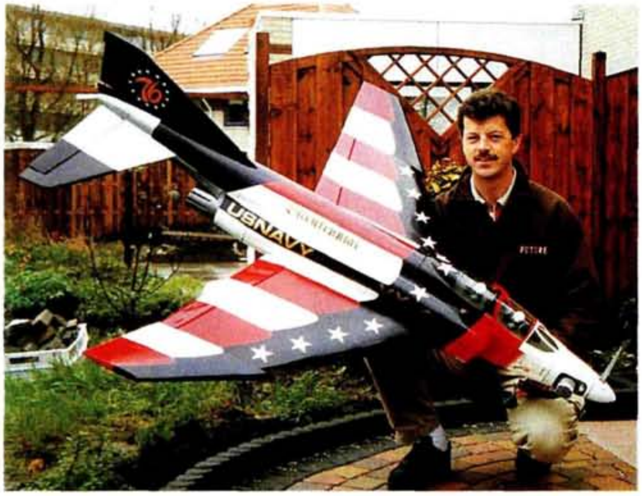
Les Heap of Melbourne, Australia, figures he must have set some sort of record with his T.D. Coupe constructed from *Model Airplane News* plans. He built the Mighty Midget-powered plane in December 1936 as a free flighter, then converted the T.D. to R/C in 1970 and went on to win three contests with it. The Coupe has been newly recovered and now sports an O.S. .28 engine, just in time for its 63rd birthday.

UNIQUE NIEUPORT

Here's a great example of some modeling ingenuity from Larry Hacker of Mabelvale, AR. He started off with Flair's 52-inch-span, sport-scale Legionnaire kit, which is based on the Nieuport 17. By omitting a few parts and adding some scale engine cylinders and a fairing behind the cowl, Larry created a Nieuport 11b. His Futaba-guided warbird is powered by an O.S. .25 FX engine with a 10x5 propeller. The plane is a slow flier, and after about a minute, the oil residue in the muffler begins to smoke; "... a happy accident!" says Larry. The 21st Century covering is adorned with MonoKote roundels, and the Native American graphics were computer generated.

NETHER-NETHER LAND

If you have a hundred or so hours to spare after spending a year building your Great Planes F4, here's a finishing job you can accomplish! Rob Kemp of the Netherlands proudly poses with his O.S. .61-powered Phantom. He used two-part automotive paint to duplicate the bicentennial design used by the Navy Test and Evaluation Squadron. Our thanks to Rob's fellow club member, Victor Rutten, for sending in the photo.



YAKKETY YAK

After growing tired of more common warbirds, Garland Haynes of Garnett, KS, found a change of pace in a *Model Airplane News* plan of a YAK-3. The K&B .65-powered warbird is painted in Siberian Arctic colors of white, blue and silver, weighs just over 7 pounds and has a homemade canopy. Garland uses a Futaba radio that operates seven servos for basic flight functions, retractable landing gear and flaps.

CAMO CONCEPT CANARD

Ernie Adamson of Bellingham, WA, didn't have his kit instructions out of order; this is actually a scratch-built model based on Focke-Wulf's 1929 concept drawings of the proposed FW-42. Ernie's $\frac{1}{12}$-scale endeavor has a wingspan of 83 inches and a canard span of 32 inches. The twin-.60-engine plane weighs 14.5 pounds and is scheduled to fly after its appearance at several mall shows. As a result of research disagreements, the full-scale version was canceled and never left the drawing board.

HONEY, I SHRUNK THE CHAMP

George Deutsch of Whitestone, NY, owns both of these Aeroncas; the full-scale version is pictured beside his Bud Nosen kit plane. The R/C version is powered by an O.S. .32 and required only slight modifications to match its "big brother." George writes, "I can say from experience that it is easier to control an airplane sitting inside one than it is to stand on the ground controlling one with just a 'box' in your hands!"

HINTS & KINKS

BY JIM NEWMAN

SEND IN YOUR IDEAS. *Model Airplane News* will give a free one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman, c/o *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877-4606 USA. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.

TUNNEL VISION

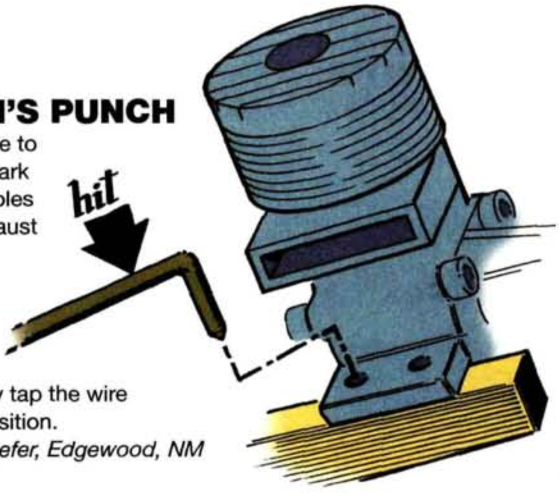
This noted designer says that to make your optical tachometer "see" better, paint the inside of the tube black. Also, to prevent the tach from accidentally being switched on, glue on this simple switch guard.

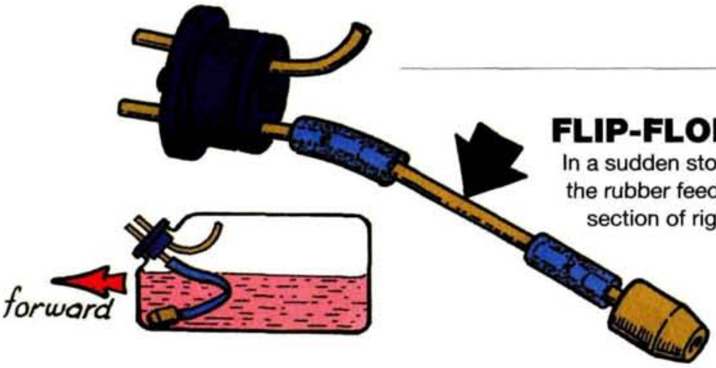
Larry Renger, Cerritos, CA

BLIND MAN'S PUNCH

It is often impossible to insert a punch to mark engine-mounting holes because of the exhaust stack overhang. Sharpen an old landing-gear wire, insert it into the holes beneath the stack and lightly tap the wire to mark the hole position.

Paul Schaefer, Edgewood, NM





FLIP-FLOPPED FEED

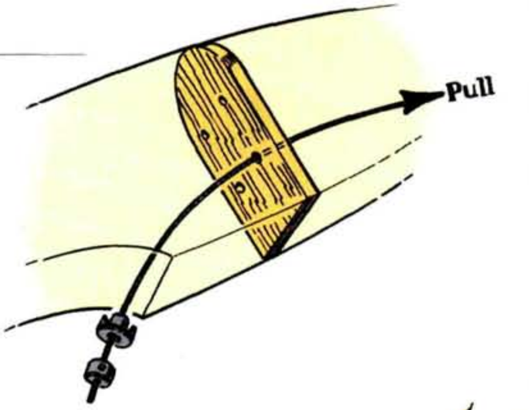
In a sudden stop, the fuel-tank flop tube can shoot forward and kink the rubber feed line, shutting off the fuel. Prevent this by adding a section of rigid brass or nylon tube, as shown by the arrow.

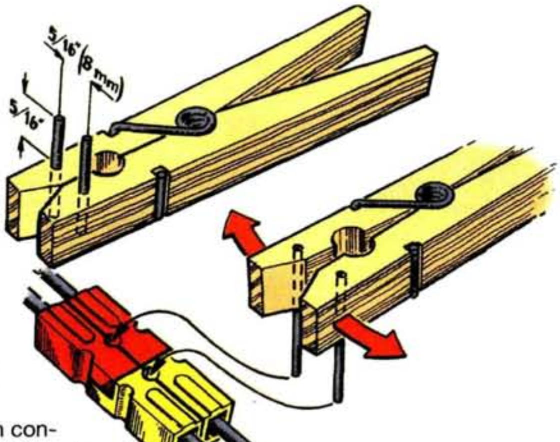
Gene Chase, Oshkosh, WI

T-NUT TUGGER

Pull T-nuts into place with a piece of cycle brake cable and a firmly attached wheel collar. Grasp the cable with pliers, then pull hard to drive the spikes into the firewall. Use a bolt and a large washer for the final seating. A dab of epoxy or CA will keep the nuts in place.

Greg Harada, Phoenix, AZ





PLUG SPREADER

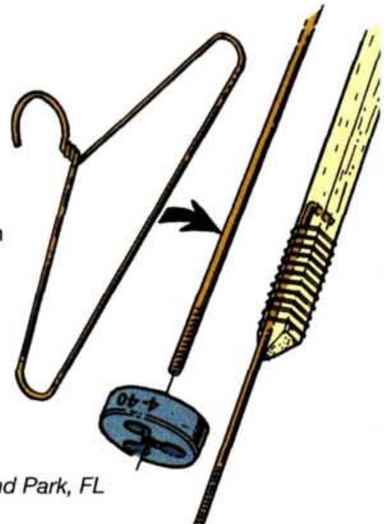
This tool makes easy work of separating Sermos connectors in confined spaces. Drill a clothespin and glue in two stout wire pins, as shown. Insert the pins into the holes in a mated pair of connectors, then squeeze the clothespin to force them apart.

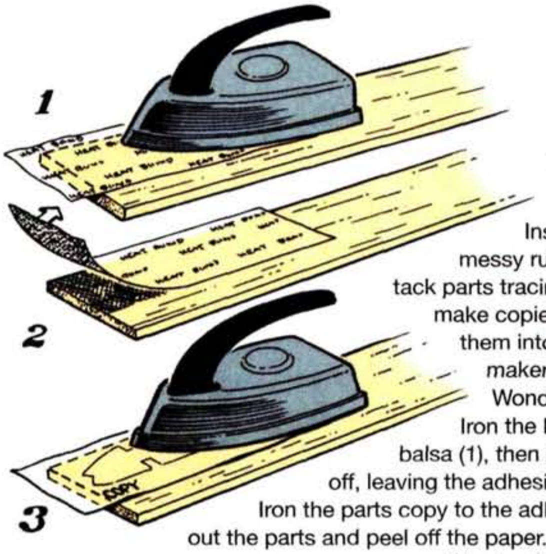
John Hannah, Delta, BC, Canada

WIRE SUPPLY

This modeler found that some coat-hanger wire is fairly rigid and measures 0.099 inch in diameter, which is the right size on which to cut a 4-40 thread. Shape, bind and glue the wire to straight-grain pine sticks or aluminum tubes to create very inexpensive pushrods for bigger models.

Warren Heinfeld, Fruitland Park, FL

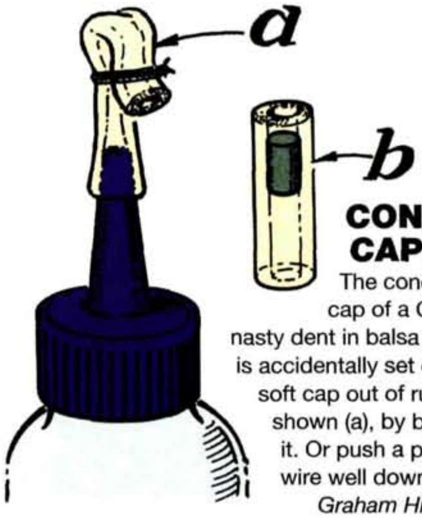




TEMPLATE TACKER

Instead of using messy rubber cement to tack parts tracings to balsa or ply, make copies, then lightly bond them into place with dressmakers' Heat Bond or Wonder Under paper. Iron the Heat Bond to the balsa (1), then immediately peel it off, leaving the adhesive on the wood (2). Iron the parts copy to the adhesive (3), then cut out the parts and peel off the paper.

Charles Garrett, Mesquite, TX



CONEHEAD CAPER

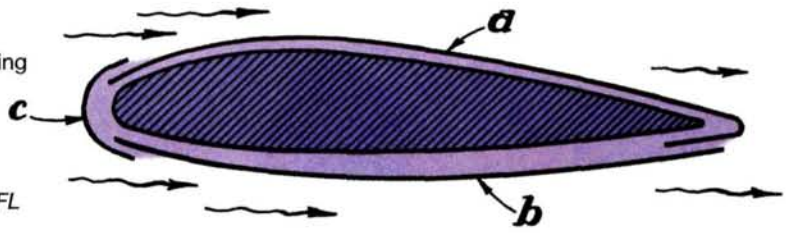
The cone-shaped plastic cap of a CA bottle can put a nasty dent in balsa sheeting if a wing is accidentally set down on it. Make a soft cap out of rubber fuel line, as shown (a), by binding cord around it. Or push a plug of plastic rod or wire well down into the tube (b).

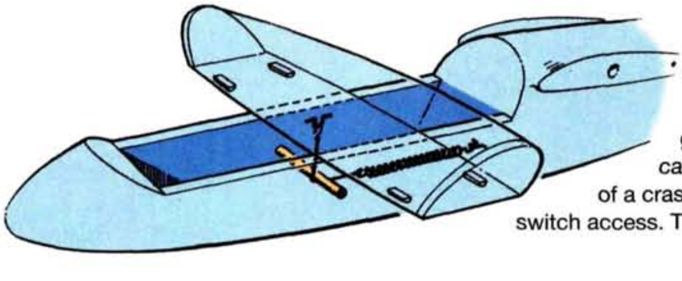
Graham Hicks, La Grande, OR

DOWNWIND TURNS

Apply covering film with all seams and overlaps facing downstream. If you apply the covering in the manner and order shown, the overlaps will not lift and allow oil to be blown below the film. The model will look neater, too.

Vince Cahill Jr., Venice, FL





HATCH LATCH

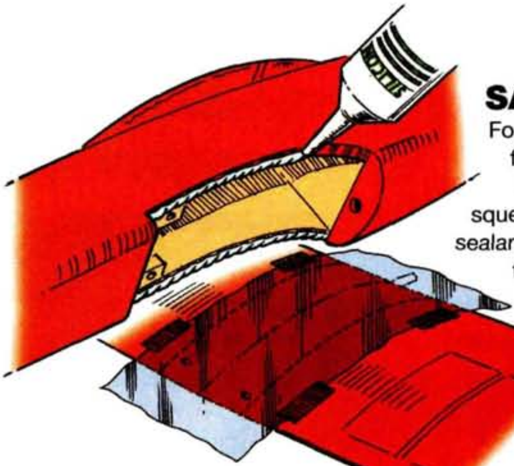
A spring from a hardware store and some stout nylon monofilament passed under a tube or dowel is a convenient way to secure a glider canopy. Split-dowel locating keys glued beneath the canopy keep it aligned, yet allow the canopy to ride up and separate from the fuselage in the event of a crash. The canopy can also be removed instantly for service and switch access. This method is superior to hooks and rubber bands.

Frans Sant, Haarlem, The Netherlands

SLUDGE PUMP FILTER

Prevent your 4-stroke engine from sucking up dirt and water through the crankcase vent by attaching a regular fuel filter, as shown. Ward says this is especially important if your engine is in a floatplane.

Ward Stewart, Penetanguishene, Ontario, Canada

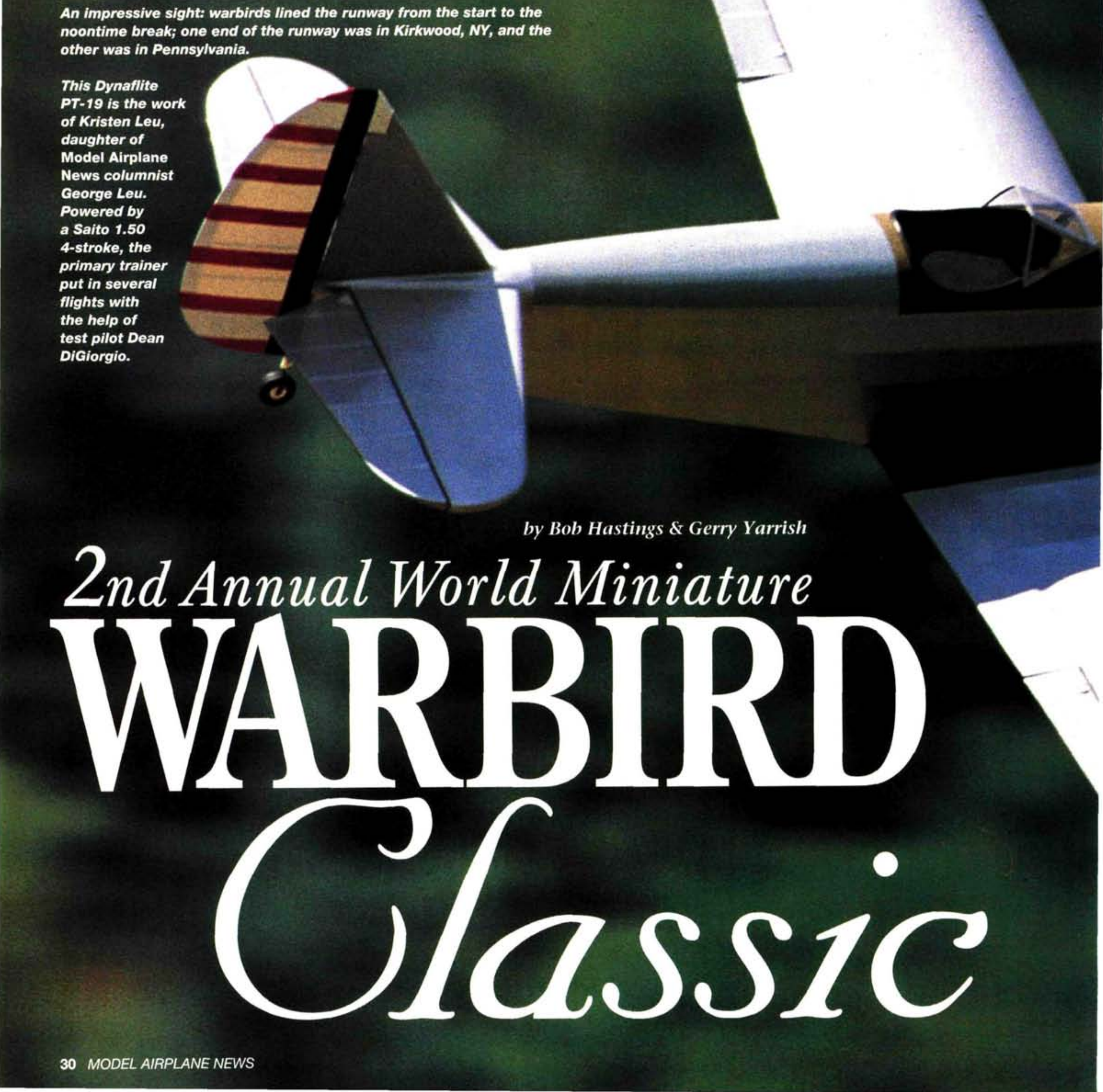


SADDLE SEAL

For a perfect wing-saddle fit, tape thin plastic film across your wing, squeeze a bead of silicone sealant along the edge of the fuselage sides, then bolt the wing into place. Allow the sealant to cure, then unbolt the fuselage and slice off the squeezed-out sealant with a new blade that has been lubricated with dish soap.

Ric Rector, Redding, CA

An impressive sight: warbirds lined the runway from the start to the noontime break; one end of the runway was in Kirkwood, NY, and the other was in Pennsylvania.



This Dynaflite PT-19 is the work of Kristen Leu, daughter of Model Airplane News columnist George Leu. Powered by a Saito 1.50 4-stroke, the primary trainer put in several flights with the help of test pilot Dean DiGiorgio.

by Bob Hastings & Gerry Yarrish

2nd Annual World Miniature WARBIRD Classic

This pusher-prop-design Blue Angels F-18 Hornet flew very well. Here it makes a slow flyby.

PHOTSS BY BOB HASTINGS & GERRY YARRISH

A celebration of military aviation

John Chevalier of Lacolle, Quebec, Canada, showed up with two Mustangs. His Meister Scale P-51D powered by a Quadra 42 heads off on another sortie.

Tom Lamar brings his razorback P-47 in for a crosswind landing; Yellow Aircraft kit.

IN ONLY ITS second year, the Miniature Warbird Classic has already matured into an event with its own personality: an ambiance created by wonderful people and aircraft and reinforced by the full-scale sod runway, dramatic aviation-movie music piped over the PA and countless flybys dedicated to the wartime aircraft of a bygone era.

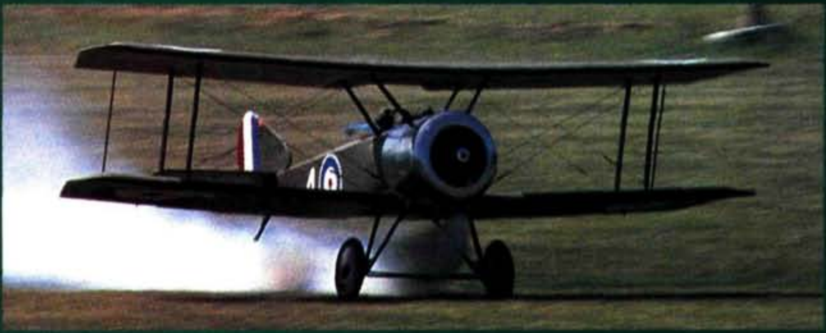
Under the auspices of the World Miniature Warbird Association (WMWA), at this event, warbird models, regardless of size or era, must be able to take off on their own and maintain an established traffic pattern.

Following these simple guidelines, pilots treated the throngs of spectators to an aerial history lesson that encompassed everything from the fragile, WW I Etrich Taube to today's blisteringly fast F/A-18 Hornet. Practically every aspect of military aviation history was represented, but no flightline judges scored the flights. The pilots' only reward was the satisfaction of sharing their passion for aviation.

Held on the last weekend in June at Kirkwood Air Park just south of Binghamton, NY, the event's location is perfect. An unofficial tally of registered pilots showed that attendance had almost doubled since the "great experiment" held last year; 190 aircraft flew more than 350 sorties. And can giant-scale warbirds and warbirds of "normal" size operate from the same flightline? The answer is an unequivocal "Yes!"

The founder of the WMWA is scale modeler Dino DiGiorgio of Succasunna, NJ. Despite some health problems over the last year, Dino continued to write the WMWA's newsletter, and with the help of his buddy Don Godfrey and many WMWA volunteers, he made the 1999 Classic a great success.

Above: designed by Rich Uravitch, the 77-inch-span WW I Fokker D-VII continues to be a popular sport-scale design. Here, complete with pilot in spiked helmet and Ernest Udet markings, Ralph Jackson's model strafes the trenches. Below left, top: with its impressive flight performance, the Fokker Dr.1 triplane remains a WW I staple. Here, Ron Prestin's plans-built triplane hunts for prey; Q-35 for power. Below right, top: winner of the Best WW I Aircraft award, Sal Calvagna "smokes" his Sopwith Pup down the runway! Below left, center: what's this?—a convertible Me-163 with the top down? No; it's Sal Calvagna's sinister Komet coming in for a landing. George Leu was the pilot when the flying wing lost its canopy. Built from Kiehl plans, the model has an O.S. 1.08 for power. Below left, bottom: a Yellow Aircraft bubble-top P-47 on a fast flyby. Below right, bottom: Nick Ziroli Sr. had a great time flying his new G-23-powered Ercoupe (military designation YO-55).



ON THE FLIGHTLINE

This year's event started with a pilots' meeting that was followed by Kate Smith's rendition of our national anthem. To honor the many who served and died for their countries, the flags of several nations were unfurled.

Spanky McKay, Ken Taylor and "Scale Techniques" columnist George Leu acted as announcers and kept the crowd well informed. The well-manicured runway was filled with aircraft, and we enjoyed five days (Wednesday through Sunday) of great flying—warbird heaven!

Four flight stations arranged and assigned according to radio frequency launched the many aircraft, and there was never a lull in the action or any long waits to fly. A few frequency pins did stay out longer than intended, but overall, all the

Continued on page 34

SUPERFINE NINE-O-NINE

For many, the highlight of the Warbird Classic was a magnificent, 41-pound, $10\frac{1}{2}$-foot-span B-17—the 909—built by Curtis Alderman. Curtis flew this Flying Fortress in an impressive formation with five P-51 Mustangs and also on several very low bombing runs (less than 3 feet off the ground).

Just as impressive as his flights was the sight of him starting the bomber's four O.S. .40 FP engines. Systematically, he always started with engine one (left, outboard) and then worked his way through the other three. When all were on line, he took out his tachometer, adjusted the needle valves for peak rpm and then backed off the revs a little. Finally, he re-adjusted three of the engines to match the one with the lowest peak rpm.

With the engines' synchronous drones and their telltale smoke trails, all of Curtis's demo flights were truly awe-inspiring.

Not surprisingly, the plywood-and-balsa 909 took $2\frac{1}{2}$ years to build, and it was appropriately completed on Memorial Day 1993. Curtis estimates that during its more than 170 flights, it has burned 70 to 80 gallons of glow fuel, and he says that, per hour, his full-scale Piper Cub is cheaper to fly than his 909 model!

SPECIFICATIONS

Plans: Bob Holman
Wingspan: 126 in.
Weight: 41 lb.
Materials: balsa and ply
Power: four O.S. .40FPs
Radio: Airtronics 6-channel
Retracts: Likes Line

FULL-SIZE CHIPPY

The WMWA Warbird Classic draws model warbirds of all types and sizes. From a $10\frac{1}{2}$-foot B-17 to $\frac{1}{12}$-scale combat fighters, Kirkwood is a safe haven for all models military.

On Saturday, a beautifully restored, full-scale de Havilland DHC-1 Chipmunk delighted the crowd when it flew in and joined the party. Owned and operated by Mike Maniatis of New York City, the all-yellow primary trainer was painted in Canadian markings. More than just a few modelers watched as Mike expertly set his priceless restoration down on the runway.

Of special interest is that Mike completely rebuilt the Chipmunk in his small apartment and had to remove a window to pass all of the parts out to be transported to a nearby airport for reassembly. Now, that's dedication!

No one was more pleased to see the Chipmunk in the landing pattern than announcer Spanky McKay, who is a retired Royal Canadian Air Force lieutenant colonel. While in service, Spanky notched up several hours in the DHC-1, and when Mike learned about this, he offered him a ride for old time's sake. For several days thereafter, Spanky couldn't erase the smile from his usually serious countenance.

For Mike, Spanky and all of the warbird modelers at the Warbird Classic, the experience was truly unforgettable.

HAWK IN THE OWL SQUADRON?

The word "warbird" usually conjures up images of the common "Stars and Bars" fighters such as Mustangs, P40s and Corsairs. That's why it was so refreshing to see such a diversity of aircraft at this event.

The fly-in was a flurry of activity, both in the pits and in the air, but when one big bird in particular cruised past, it grabbed everyone's attention. The airplane in question was a 46-pound, 8-foot-span, ¼-scale Curtiss P6E Hawk biplane, and the guy holding the transmitter was Walt Basiago of Summit Hill, PA.

Walt is as cordial as he is skilled at flying, and he truly exemplifies the spirit of a fly-in. Before it's flown, his plane requires approximately 20 to 30 minutes of rigging. Its unique markings are those of the Michigan Snow Owl Squadron, and they've been carefully detailed, right down to the "claw" wheel pants.

Under the cowl? This military marvel is powered by a Sachs 5.8 spinning a Master Airscrew 24x10.

SPECIFICATIONS

Plans: Wendell Hostetler
Wingspan: 96 in.
Weight: 46 lb.
Materials: balsa and ply
Power: Sachs 5.8ci

SPECIAL AWARDS

On Saturday night, everyone showed up at the chow hall (the Kirkwood Airfield hangar) for great food, interesting conversation and the presentation of WMWA Special Achievement awards.

1999 Awards

Best WW I	Sal Calvagna, Sopwith Pup
Best WW II	Dean DiGiorgio and Bill Stevick, P-51 Mustang
Best Jet	Larry Wright, scratch-built F-86 Sabre Jet
Technical Achievement	Curtis Alderman, B-17 Flying Fortress

Special recognition

- **Nick Ziroli Sr., for his continued support and development of giant warbird designs.**
- **Roy Vaillancourt, for his involvement in giant-scale warbirds and for founding Miniature Warbirds Limited.**

Sponsorship recognition

- **Airtronics and Robart Mfg., for their continued support of the World Miniature Warbird Association.**

Continued from page 32

pilots flew as they had hoped to.

The traffic pattern was one of giant-scale models making large, impressive circuits outside the orbits of the smaller, glow-powered warbirds. This air segregation developed naturally—almost unintentionally—last year, and again this year, it worked well and kept "the big and the little" on speaking terms! The camaraderie kept everyone smiling and really impressed us. Good times, good friends and great-looking warbird flights; what more could anyone ask?

VETERANS AND FLEDGLINGS

This year, the regular warbird crowd shared the flightline with many first-timers, and it is always a pleasure to see the old birds and fledglings get airborne together. Several P-51 Mustangs (built from Dick Sarpolis plans and Dynaflite kits) completed their missions, and 11-year-old Paul Sitler (now a full WMWA "colonel") was again there defending the trenches. Paul and his dad, Bill, always have a good time flying.

Veteran troops such as Nick Ziroli Sr., Bill Steffes and Sal Calvagna were also on duty and right in the groove. At one point, Nick flew his giant Skyraider so low that he even impressed himself! The sight of this spectacular warbird coming in for a low-level strafing pass was simply awesome! Sal flew everything from a ⅓-scale, WW I Sopwith Pup to an O.S. 1.08-powered Me-163 flying wing, and he did a splendid job—complete with smoke!

Sal was there with several other members of the WMWA 117th Composite Wing of Long Island, NY. The Long Island Skyhawks were also well represented and, between them, they seemed to have one of every one of Nick Ziroli's designs; from Hellcats and Texans to Taubes and triplanes, the "Z squadron" ruled the sky.

The Warbird Classic has truly developed into something special, and all involved deserve a big "Well done!" The atmosphere is friendly and the flying is spectacular; whether you're a warbird modeler or more of a military historian type, mark the last weekend in June on your calendar; it's definitely a must-attend event. Try to be there in 2000; we know you'll be glad you did.

For more information on the WMWA and the Kirkwood Warbird Classic, contact Dino DiGiorgio, P.O. Box 175, Succasunna, NJ 07876; (973) 584-6096. You can also check out the organization's rapidly developing website at www.aero-sports.com/warbirds/wbhome.html. See ya on the front!

The MiG at rest shows the wide-stance gear and low-slung stature that allow flawless takeoffs and landings. The American markings are unusual but accurate. The full-scale bird was flown to South Korea for $100,000 by a defecting pilot. ProMark helped with the markings and masking templates.

by Frank Tiano

BOB VIOLETT MODELS MiG 15

THE FOLLOWING IS a review of the Bob Violett Models* MiG 15 kit. It is a no-kidding review—not the kind in which the author takes you step by step and explains how he, or ultimately you, will build a model. No, I assume that any modeler who's willing to plunk down a sizable amount of change for a project will already know how to build a model airplane. And, hopefully, he will also have some experience with jet model aircraft. As a bonus, it would be nice if he has attended a jet-fly or two and been up close and personal with manufacturers' reps and seen their equipment in use.

That's me, Frank Tiano, with the MiG just minutes before its first flight. The planform is actually square, 68x68 inches—a very sturdy design.

At first, some might ask why a magazine would feature a review of such a costly project. And that's a good question—one that I am able to answer with confidence and knowledge. It's because, believe it or not, turbine-powered scale models that perform well are the fastest, hottest-selling things on the planet today. No, they are not for everybody, but enough guys out there are smacking their lips, swapping stuff around and selling everything in sight just so they can muster up enough cash to buy a turbine! It's true, I promise!

Just before touchdown, the MiG is banked ever so slightly to the right with neutral elevator. The shock-absorbing gear really do a great job.

Right: this squadron of BVM MiGs should give you an idea of the many color schemes available.

On a slow flyby at about $^1/_3$ throttle, the speed brakes are out to slow it down. This is a very stable machine—one that should have hundreds of flights.

Getting into turbine-powered jets is easy ***if you have the right stuff!***

WHY THE BVM MiG-15?

When I'm ready to write a check, I want to be sure that what I'm buying is gonna work; and I help to ensure this by going to fly-ins and competitions to see what, exactly, works out there. I've been flying jets and scale models long enough to know that Bob Violett Models (BVM) has a dynamite reputation. I have probably purchased more than a dozen BVM kits in my life and have found every one of them more than satisfactory; and they all flew extremely well. So, after seeing the prototype MiG-15, I decided I'd like to have one for competition. (Oh, yes; just in case you're wondering, I paid for the kit and accessories.) BVM's MiG-15 is a delightful sport or competition model that's rugged and serviceable yet user-friendly and really cool to look at.

BACK TO BASICS

Most of the scale jet kits available today feature fiberglass fuselages and some sort of foam wings. The folks at BVM have strayed from the norm, even for them, by producing the MiG in two versions: one for turbine and one for ducted-fan applications. Both feature built-up wing and stab structures. I like built-up wings because, as a builder, I can see exactly where the components fit and how they clear or interfere with other parts. The MiG's laser-cut wooden parts are a refreshing change from the die-crunched parts I've seen in some lesser examples, and the parts all fit precisely as shown on the magnificent set of CAD-drawn plans. Every piece of wood needed is called out by dimension and position, and the parts for each subassembly come in separate bags. You have to go extremely far out of your way to screw this one up!

BVM's instruction booklet flows smoothly from one step to the next and contains great directions as well as some professional photos. Well-drawn plans, clearly labeled with building hints; a well-thought-out construction manual; labeled parts bags; high-quality, laser-cut parts and materials all belong in today's higher level kits. In that regard, BVM has done admirably.

SPECIFICATIONS

Model: MiG-15

Type: $^1/_6$-scale jet

Manufacturer: Bob Violett Models

Wingspan: 68 in.

Length: 68 in.

Airfoil: scale, semisymmetrical

Wing area: 920 sq. in.

Wing loading: 50 oz./sq. ft.

Flying weight: 20 lb.

Radio req'd: 8-channel programmable

Radio used: Airtronics Stylus

Engine rec'd: turbine and ducted-fan kit versions available

Engine used: RAM 750 turbine

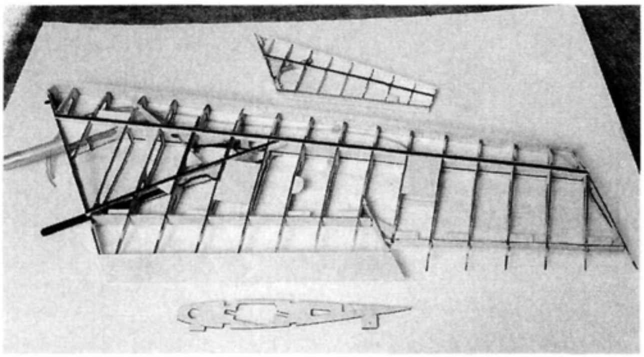
List price: $1,550

Features: fiberglass/composite fuselage, built-up wing, fiberglass accessories.

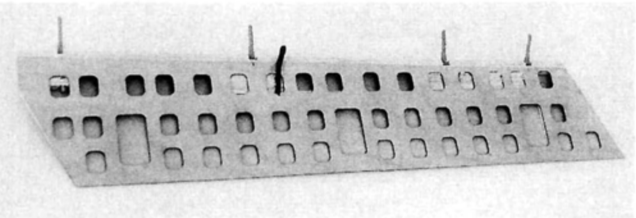
Comments: the BVM MiG-15 is an excellent scale model for sport or competition. It's easy to build and even easier to fly—a perfect first jet.

Hits
- Workmanship is outstanding in every way.
- "Complete kit" concept; all options are available from the manufacturer.
- Terrific flight qualities; not intimidating at all.
- Informative and user-friendly instructions.

Misses
- No wingtip lights included.



The wing and stab construction with the top surface sheeted. The aluminum wing-mounting tube has been installed, as has the carbon-fiber rear support spar. Notice how clean the laser-cut rib looks.



All the holes in the flap skin are laser-cut; this makes for fast building and a structure that retains the scale appearance. Robart* hinges are used throughout.

BACK TO THE FUTURE

Although the balsa and plywood wing and stab structures can be considered basic construction, the rest of the MiG is certainly futuristic in nature. The fuselage is expertly manufactured out of epoxy fiberglass and has all panel lines scribed in scale locations. The vertical fin is a true work of art; it is not only a separate fiberglass component but is removable as well, so you can easily ship the MiG in a legal-size, BVM fiberglass jet container. The fin incorporates all the linkage needed for the rudder and the elevators and houses their respective servos as well.

The plans tell which type of servo you should use for each component. Jets travel fast, and they require high-quality servos. BVM shows us linkages that, if installed as directed, will ensure many safe, flutter-free flights while putting the least possible stress on the servos.

The method used to mount the separate wing panels is not only clever but also extremely strong and safe. As the wings are plugged into the fuselage, all air connections are made at the same time, so there's no fussing around with connectors and flopping air lines. It's a neat and simple procedure and one that I hope to incorporate in all my future scale models. An especially nice touch is that the fiberglass parts are so well gelcoated that they require a minimum of preparation before finishing—just a medium-pressure scuffing up, a very light coat of primer, and they're ready for paint.

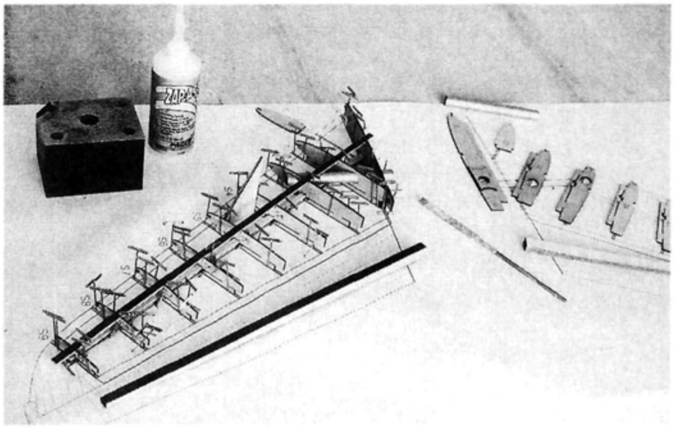
Speaking of finishing, BVM takes the time to specify products for various stages of construction. It does this for a reason: over many years, the folks there have learned what works and what doesn't. Armed with that knowledge, they recommend products that they know work, and they can supply them. It keeps the guessing game to an absolute minimum, and I like that. No guessing: no experimentation—just building! Aces again; this is possibly the best overall exercise of bringing a kit together that I have seen to date.

Another thing that should please most scale modelers is the supplied four-page brochure that includes several color schemes for the MiG. You may think that all MiGs were painted silver or left natural aluminum; not so, kerosene breath! Lots of them were used as aerobatic team airplanes; some were used as fighter/bombers for small, third-world countries; and still others were used for training. Color schemes include various camouflage patterns, silver with vast splashes of red and those of brightly colored display aircraft. Best of all, if the MiG you like has more markings than you are in the mood to paint, Jerry Caudle's company, ProMark*, makes all kinds of dry-transfer lettering, markings and "rivets" for the MiG (and any other subject as well). Or, if you prefer, ProMark can also make very accurate stencils. I used a combo of dry transfers and stencils. The nice thing about ProMark's dry-transfer stuff is that it's fuelproof and mostly solvent-proof! Yup; the numbers on my MiG's nose are ProMark rub-off lettering and don't have a clear coat applied over them. They have held up for several months now with no problem whatsoever.

One last comment about the components: I did not find one single area in which the parts did not fit or fit poorly. Yes, because I had received kit number two or three, there were certainly some mislabeled parts, but those errors have been corrected. The important thing is that when the correct parts arrived, they fit perfectly. Every subassembly that the modeler completes himself will fit in exactly the way it is supposed to. In fact, if it doesn't, you have done something wrong!

EXTRA, EXTRA!

No, newspaper man, I'm not talking about a headline here. As in any scale kit, you'll have to buy some accessories if you ever want to get a chance of catching daylight under the main gear. You will need premolded fuel tanks that can be stuffed into a specific area so the MiG can use all the fuel it needs for its many sorties without its CG being affected. If you want to fly the MiG on a turbine, the safest fuel tanks are of molded Kevlar (which will remain intact in the event of a mishap). Along with the custom fuel cells, you'll need landing gear—a definite must for takeoffs! Some folks might consider a custom- or specially built set of gear a miss instead of a hit because they think in terms of average models where, if you whack the thing, you can always use some of the parts on another bird. Sorry, but that thinking has become a bit outdated when you deal with jet model aircraft. Because everything must work perfectly and reliably, it's best to design a specific set of gear and other parts for that particular model. The MiG is no exception. Its gear is a bit loony to look at: it sweeps back, retracts at a ridiculous angle and has a tire that is not perpendicular to the runway! BVM had to design and manufacture its own MiG gear. The first units were OK, featuring the correct angles and robust chassis, but they tended to be a little sloppy after several flights—especially if you flew off grass. Since then, BVM has changed the material in the nose gear and updated the main gear to allow numerous, slop-free retractions. The final version is as good as you might ask for. But then, as I mentioned before, I have come to expect that any part of a BVM kit that



Early on in stab construction: a true building board is a must. BVM recommends a high-quality piece of ceiling tile for this. Carbon-fiber strips along the spars help to strengthen the stab but add very little weight.

was suspect of not being just right would be corrected. It was, and I am a happy pilot. And you will be, too!

Many areas of the MiG are quite futuristic: for example, many time-saving (for the buyer) procedures have been done at the factory. Consider the planning that went into the design of the rear dive brakes: airline tubing was specially routed; special air cylinders and mounts were incorporated; and all the angles of extension and retraction were plotted out by means of CAD and applied directly to the kit. Guess what? They worked perfectly the very first time. The MiG comes with cannon blisters, a removable top hatch, a perfectly scaled inlet and special hinges for the landing-gear doors—everything necessary to make the model look like a miniature MiG and not a plastic toy.

GEARING UP

When we say we are gearing up a jet, we simply mean that we are installing the engine, radio and linkages. In this case, the linkages are installed as you construct the model and, in some cases, servos were added along the way to save time later. If you have been to a few jet events, you've noticed that turbine aircraft accelerate very quickly and are capable of flying at very high speeds. Experienced pilots rarely fly at full throttle to avoid stressing an airframe. Flutter and fatigue are the jet pilot's enemy; be very careful never to give either the opportunity to manifest itself in your airframe. One of the ways to do this is to insist on only the very best radio equipment coupled to strong, properly installed linkages. I chose the Airtronics* Stylus radio for several reasons, including that I have rarely seen a competition pilot have a problem with Airtronics stuff and that the choice of Airtronics servos is almost without limits. The MiG has two servos for steering: one for rudder and one for nose gear. It also has one each for elevator and landing gear; one to operate the air-control valve for the dive brakes; two each for ailerons and flaps; and one for throttle in the ducted-fan version. I have some 30 flights on the MiG and have yet to observe any deterioration of an Airtronics component.

I chose my turbine engine for the very same reasons as I chose the kit and the radio: I saw the first turbine, a JPX, fly on propane at Top Gun about six years ago. I was impressed only by the sound—certainly not the performance! The following year, Bob Violett came to Top Gun with a competitive turbine-powered model and did very well. As time went by, I saw other turbines introduced. Some were neat looking and operated well; others were cantankerous, at best. The major breakthrough was the introduction of engines that operated on kerosene instead of propane. Again, I observed with interest. When the

FLIGHT PERFORMANCE

• TAKEOFF AND LANDING

A couple of seconds elapse between when you advance the throttle stick and when the RAM actually goes to full throttle. This is called "lag," and you get used to it quickly. After several minutes of taxiing, you come to realize that you must stay ahead of the throttle, not lag behind it. I think you might call it "anticipation"! I drove the MiG out to the middle of a closed airport runway and lined it up on the centerline. I advanced the throttle slowly at first, listening to the turbine's muted roar. After maybe 30 feet, I was certain that the MiG was tracking straight, and I nailed the throttle and watched it accelerate. After about 150 more feet or so, Pat McCurry advised liftoff, and a little backpressure on the Stylus's stick resulted in a pretty good-looking, smooth takeoff. No trim was required at all. The sound? Awesome!

Landings with a turbine are a bit different for a few reasons. For one thing, they take some getting used to because the absence of noise does not mean an absence of airspeed. Even ducted-fan jets don't slow down quickly if the engine is running. So Pat advised me to go to low throttle about halfway through the downwind leg and, sure enough, the MiG sailed all around the pattern at idle and landed almost right in front of us in a level attitude. I had lowered the gear just after reducing the throttle and lowered the flaps soon afterward. Just before turning to base, I activated the speed brakes, and the model just hung in a level attitude while losing altitude. A little up-elevator at about 2 feet of altitude was all it needed to settle in softly. Landing would take some practice if a pilot had absolutely no jet experience whatsoever, but it isn't difficult to master.

• LOW-SPEED PERFORMANCE

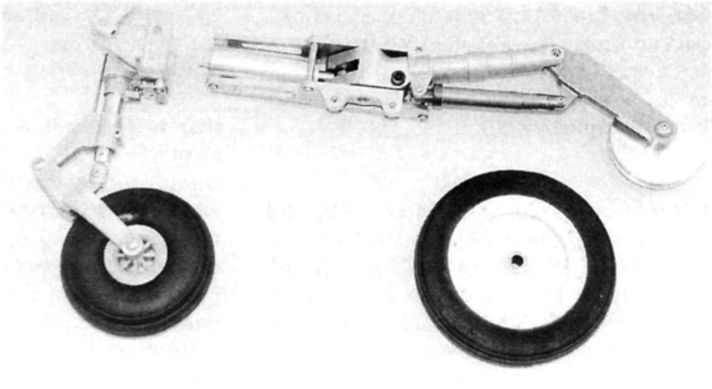
Oh, boy; what a gem! Pat asked for some low flybys so he could take some photos, so I made a gentle turn and brought the MiG parallel to us with the boards and flaps down. The thing just hung there at maybe 30mph. None of us could really believe how stable and slow this bird could fly. We believe it now. The ailerons get just a little bit mushy near the gentle, nose-down stall, and there is plenty of time to power up and recover if you've gotten a bit too slow.

• HIGH-SPEED PERFORMANCE

Oh, boy! I made the mistake of blasting the throttle wide open as I was climbing out from a pass along the far side of the runway, and the MiG was a dot in the sky in half a heartbeat! No kidding. It's not like a rocket ship, but it is breathtaking nevertheless. Bob says its top speed is right around 180mph, but I don't think anybody has any fun at that speed. I mean, think about it: the thing is flying at 180mph, or 3 miles per minute. That's 264 feet per second. So, if my calculator is working properly, that means that the MiG is a 1/4 mile away from me in 5 seconds. Count 'em: one thousand one; one thousand two .... That's why you don't fly this plane at max throttle. Plus, why stress the airframe for no good reason? Therefore, I did most of the high-speed stuff at just a crack over 1/2 throttle or maybe 100mph—plenty fast for most maneuvers—and it looked great.

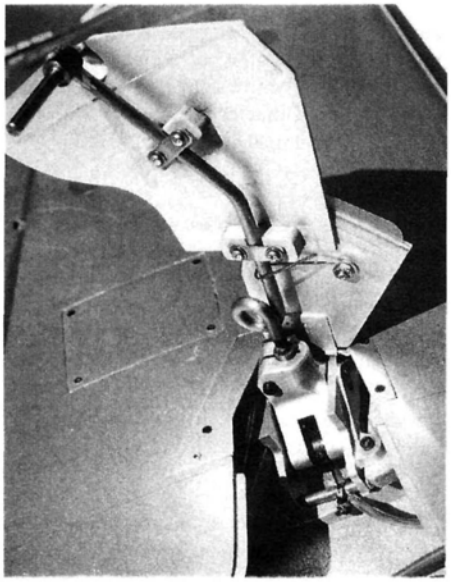
• AEROBATICS

Other than aerobatic maneuvers reserved for propeller-driven aircraft, the MiG can and will do everything. It is so predictable that I have let several friends fly it, and they all said that with minor stick changes to suit their flying style (taller or shorter sticks or exponential in or out), they could really get to love the airplane. All agreed it is a real pussycat. Because it's a mid-wing design, the MiG is very neat around its axes. All rolling maneuvers look as if they are perfectly executed. Two- and four-point rolls are exciting to watch, and slow rolls are just heaven. Any vertical maneuver becomes especially exciting with a blast of power. The large fin provides great knife-edge characteristics.



The scale gear—nose gear to the left, main to the right—and their appropriate tires and wheels. The main gear have air-operated brakes as well. For sport fliers, BVM offers a heavy-duty, preformed 3/16-inch wire strut.

dust settled in 1998, the writing was on the wall, and I was not too blind to see. One particular kerosene-powered turbine engine seemed to operate nearly flawlessly, had a neat appearance, put out bunches of power and was dirt simple to set up and run. On top of this, it had an attractive price, was manufactured right here in the USA and had a no-kidding repair shop and spare-parts program. We know it now as the RAM* 750. RAM stands for Rei and Albert's Microjets, which was founded by Rei Gonzalez and Albert Araujo of Miami, FL. What really helped me to make up my mind was seeing Bob Violett put three of those little suckers in three of his most



A look at the main gear unit coupled to the sport wire strut. It's perfectly suited to rough fields or non-contest work, and it costs a lot less.

trustworthy jets and go out there and fly the bejesus out of them at jet fly after jet fly with few problems.

The rest is history. I have a RAM 750 in the MiG. It burns kerosene mixed with oil, so I don't have an oil pump like some others do. It comes with a little gizmo called the "ECU" (electronic control unit), and this little box does everything from starting the RAM to setting the endpoints of the throttle and even keeping the temperatures and pressures in check while it's airborne. The RAM 750 is small and compact and roars like a Pratt & Whitney. It has a very low throttle lag—less than what might be experienced with a turbine—and it runs extremely cool.

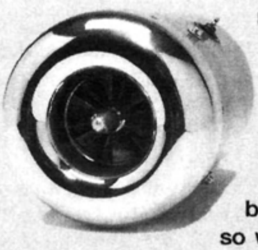
THE END

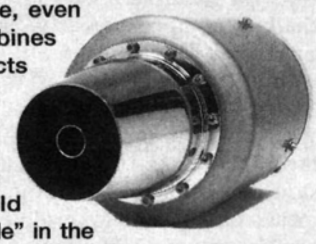
I can sum up the total MiG, RAM and Airtronics experience in just a few lines. The BVM MiG-15 kit is all you could possibly ask for in any kit, jet or otherwise. It is extremely comforting to know ahead of time that the building job before you will be enjoyable and to the point. It is good to know that the parts will fit and that the completed airplane stands a 100-percent chance of completing its first flight. As a bonus, you will learn many new model-building techniques that you'll be able to apply to your next model, regardless of type. The Stylus radio is all I had hoped for and more. It is especially rewarding to know that I can call Airtronics and get a person who actually knows the radio I fly with. Airtronics' stuff works, and that makes me very happy. And that little gem of an engine certainly looks as though the RAM 750 will be the barometer for all other turbines for quite some time because of its power, appearance and reliability. This reviewer gives all three products two thumbs up!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

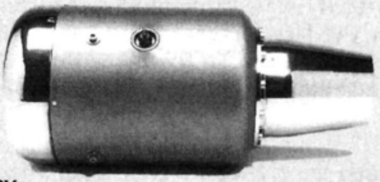
RAM 750F TURBINE

The increasing availability of miniature, true turbine engines is changing the face of R/C jet modeling forever. Because of them, jet models are not only sounding full scale, but, in the case of those that run on kerosene, even smelling full scale! Moreover, turbines make many more scale subjects viable as models than were previously possible with ducted-fan equipment. An F105, for example, with its small wing-root intakes would need an ugly large "cheater hole" in the bottom of the fuselage for proper ducted-fan operation—not so with a turbine. As a result, turbines are creating jet interest among modelers who weren't previously enamored with piston-driven ducted-fan propulsion.





Pictured here is the R.A. Microjets* RAM 750F—the powerplant used in the MiG 15 reviewed here. The RAM 750F produces 18.5 pounds of thrust at 120,000rpm.



RAM was the first model turbine to have its turbine wheel, the most critical part of the of any turbine, cast at an FAA-approved foundry to meet current full-scale turbine blade standards set by the FAA, Pratt & Whitney and Rolls Royce. According to the manufacturer, RAM is the only turbine currently available with a true containment ring (made of ½-inch stainless steel) around the turbine. All RAM engines come complete with everything needed to install and run them. These items include: engine data terminal with simple start system, electronic control unit (ECU), pump, battery, propane valve, all fittings and mounts.

This is the start/data terminal. With the advent of this unit, referred to by some as the "starter box," model turbines made a tremendous leap in terms of being more user-friendly. RAM was the first with it. This little box has a readout display that walks you through the start-up procedure, which is simply controlled with two spring-loaded switches: one spools up the engine with compressed air, and the other ignites the engine with propane and automatically switches over to kerosene when released.

The display on the start/data terminal tells you which switch to throw and when to throw it. The sequence goes something like this: glow plug on (button controlled, spool up with compressed air, propane start-up and automatic switch to kerosene when running temp is reached). Again, each step is read out on the display as you go along, making this two-switch start-up procedure not only incredibly easy, but also much safer than ever before.

The on-board ECU communicates with the start/data terminal so you know exactly what's going on with the engine via the read-out display on the data box. The ECU monitors such things as exhaust-gas temperature and fuel flow (both propane and kerosene); it governs high and low throttle points and controls fuel-pump speed for desired throttle setting. If trouble is encountered, the ECU will let you know where the problem is via the engine data box display.

MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW

HANGAR 9 ADVANCE

WHEN I WANTED A NEW plane quickly, favorable comments within various Internet news groups pointed me to the Hangar 9* VRTF (virtually ready to fly) Advance 40. Fellow hobbyists wrote about its conventional balsa and lite-ply construction, bolt-on tail group, factory-hinged control surfaces, engine mount and installed control horns; they noted that out of the box, the Advance 40 had everything but the radio, engine and fuel needed to get it into the air. They were right!

CONSTRUCTION

I found the plane well packaged, with its parts separately bagged and partitioned within the box. The Ultracote covering was tight and neatly done, with trim work I would be proud to call my own.

Following along with Hangar 9's photo-illustrated instruction manual, I tested the hinged surfaces with a strong pull before starting to build; all passed satisfactorily. I removed the installed fuel tank, inspected for leaks, and made certain the stopper was tight. The tank's fuel and pressure tubing exit the fuselage through a large hole in the firewall that I sealed with some Innovative Model Products* PFM.

Factory-applied Ultracote covering is very attractive and highly visible in the air.

WING ASSEMBLY

I performed a trial-fit of the wooden dihedral brace. The brace also doubles as the wing joiner into the channel of both wing panels. Next, I mixed the supplied epoxy, coated the wing roots and installed the dihedral brace. I joined the wing halves, keeping the brace centered. One wing panel remains flat on your bench; the other tip is propped up to set the dihedral at $2\frac{1}{8}$ inches. Tape is then stretched across the bottom wing joint, which ensures a clean, even bond.

I was tempted to fiberglass the center joint; however, the customer-service people at Hangar 9 told me the wing would withstand fairly strenuous aerobatics without it.

Installing the servos and the radio in this kit was easier than in any other kit I have built. The three fuselage-mounted servos drop into precut holes in a sheet already glued into the fuselage. The battery and the receiver are then mounted to the Shock-Loc tray with rubber bands and the supplied double-sided tape. The tray itself fits over the three servos and is attached to the mounting plate with six wood screws. This was easier to do than to describe!

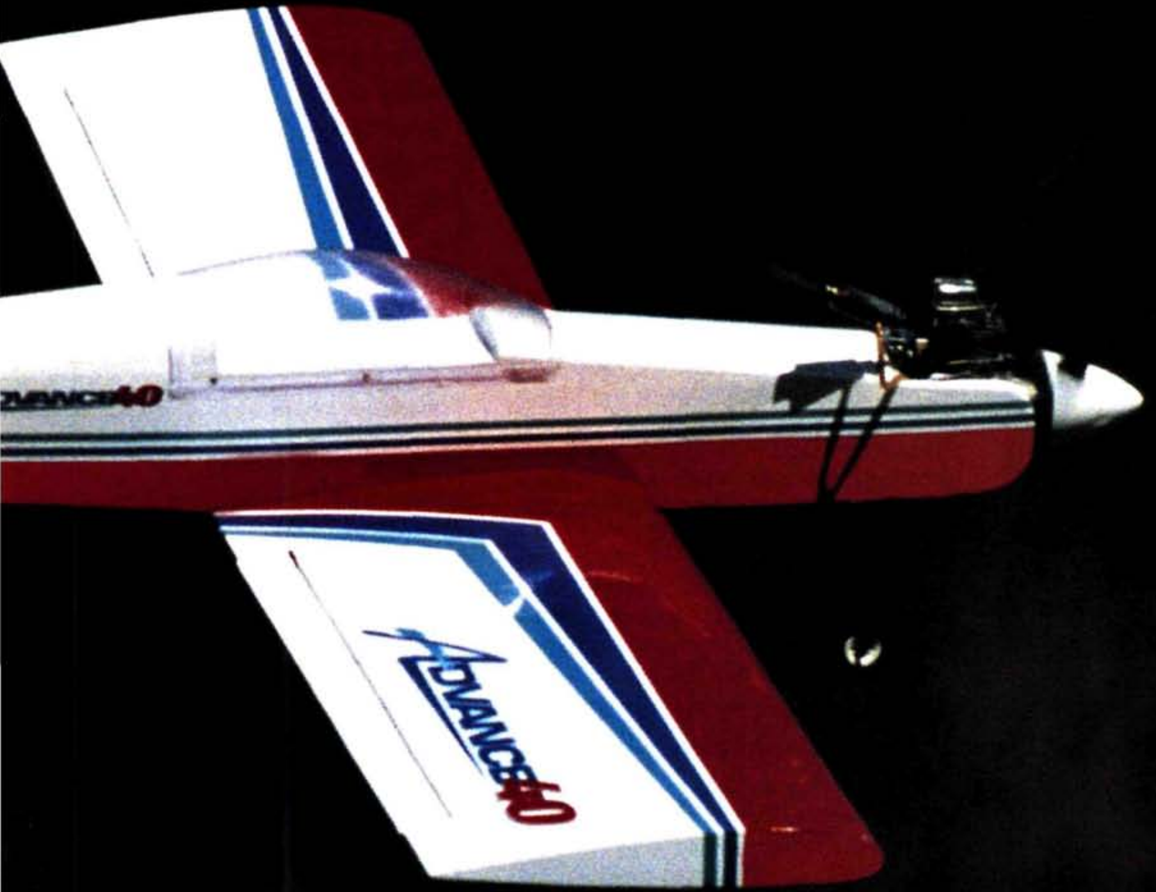
The pushrods to the tail were already in place, so it was easy to screw the clevises onto their front ends and attach them to the servo arms. The pushrod to the nose wheel was easily threaded through the holes in the formers in the front of the fuselage, though I adjusted its length and throw to obtain maximum rudder movement. The manufacturer suggests a neat trick to install the throttle pushrod: thread flexible antenna tubing through the holes designed for the throttle pushrod, screw the pushrod into the tube that's in the fuselage and pull the tube back out through the front. This works like a charm, and makes it possible to use a solid wire following a curved path for the throttle. I mounted the switch and charging outlet using a Du-Bro* Kwik Switch Mount and proceeded on to the tail feathers.

TAIL ASSEMBLY

The vertical fin has two bolts glued into its base; these bolts pass through holes in the horizontal stab and are held in place with wing nuts. One of the bolts was loose, so I repaired it with a touch of CA. Both seemed to be at a slight angle, so I bent them carefully to get the rudder perpendicular to the elevator. The rudder/ elevator assembly is then attached with small metric bolts that go through premounted sad-

40 VRTF *Limber low-wing with low build time*

by John W. Philbrick



dle blocks and thread into blind nuts on the top of the elevator. The bolts didn't fully engage the blind nuts, so I replaced them with slightly longer bolts.

With the tail surfaces in place, it was a snap to install the clevises on the pushrods (one for the rudder and one for each side of the elevator), including the supplied safety tubing to ensure that the clevises stayed shut once in place. The manufacturer provides no control-throw measurements, but building it as directed results in a nicely controllable, maneuverable plane.

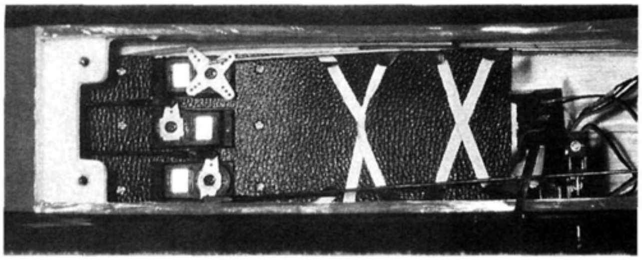
COMPLETING THE FUSELAGE

The Advance 40 has tricycle landing gear. The wing-mounted gear attaches to pre-installed and grooved hardwood blocks. The mounting blocks needed a little drilling to accept the self-tapping screws for the landing-gear straps.

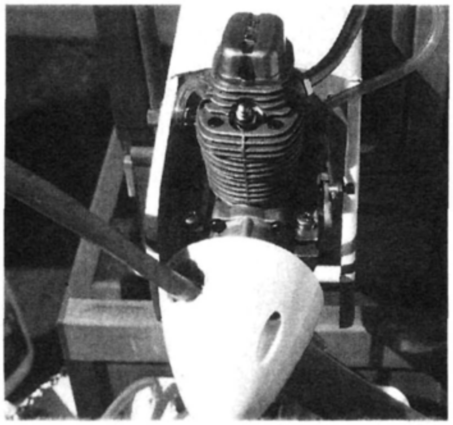
The nose wheel is easy to install. The supplied steering arm limits its vertical movement between a lower pivot and the traditional hole in the engine mount. I adjusted the nose gear so that the plane sits level and completed the installation with the provided wheels and wheel collars.

Hangar 9 supplies an aluminum engine mount that's attached to the firewall. I tightened the mounting bolts and secured them with the supplied threadlocker. To fit my long Enya* 4-stroke in the mount, I drilled a flat-bottom hole to recess one attachment bolt and made a slightly shorter pushrod with a Du-Bro 4-stroke throttle-linkage kit. The 4mm bolts that hold the engine in place were just a little short for my engine, so I replaced them with slightly longer ones and supplemented the supplied threadlocker with lock washers. As a nice touch, the nuts for the clamp bolts fit into hexagonal recesses on the bottom of the mount, so you only need a screwdriver to install the engine. The supplied spinner needed a little trimming to fit over my 11x7 prop, but it would have fit perfectly on a 10x6. It was nice to have the spinner come in the kit and not have to buy another accessory.

The canopy installation was the easiest I've ever experienced. Hangar 9 recommends using the supplied tape to hold the canopy in place, then attaching it permanently with the supplied screws. The canopy comes with three holes on each side; after carefully adjusting it to get it even on both sides, the screws then hold it in place. I chose to do it the opposite way, but the recommended approach would have been better, as it leaves the tape smooth under the screw heads rather than bulging over them.



The Shock-Loc tray isolates the radio gear and holds the fuselage servos in place.



The author uses a 4-stroke Enya .54 in the pre-installed motor mount.

INSTALLING THE WING

The wing is attached to the fuselage at the front with a tab formed by an extension of the two center ribs. To seat the wing properly, I had to sand the slot in the former that receives the tab, and the fuselage behind the saddle. The predrilled and installed hold-down bolts easily engaged the pre-installed blind nuts in the fuselage for a tight and firm mounting.

The elevator was tilted with respect to the wing. I hadn't applied the thread-lock compound to the elevator-mounting bolts; this was fixed relatively easily by shimming the elevator saddle with four strips of masking tape on one side until alignment was correct. The plane balanced exactly as specified when I checked it with a Du-Bro airplane balancing stand.

FINAL THOUGHTS

The flight test proved the Advance 40's construction and satisfied me as to its strength, and I recommend it very highly. The plane looks good on the ground and flies wonderfully. If it is damaged, repairs should be easy using conventional techniques or by purchasing available replacement parts. The Advance 40 is a model with a very wide range of performance capabilities. Its slow-speed stability and forgiving stall characteristics make it capable of performing as a trainer. With the Enya .54, the model has the power and agility to perform basic pattern maneuvers with ease. For fun-flying, add a little more aileron throw, and seal the hinge gaps for a model that performs "bat turns" with the best. This will be my primary plane for quite a while!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

FLIGHT PERFORMANCE

• TAKEOFF AND LANDING

I advanced the Enya .54's throttle to half power, and the takeoff roll on our grass field was straight with little steering input required. The model was airborne in about 100 feet, climbing out with authority. A full-power climb-out can be made at a 70-degree-pitch angle.

The landing approach at a slight nose-high attitude was very stable in roll, pitch and yaw. I cut power to idle at about 10 feet in altitude with a small flare before contacting the runway. Touch-and-go's were accomplished with 50-percent power, producing a scale-like climb-out.

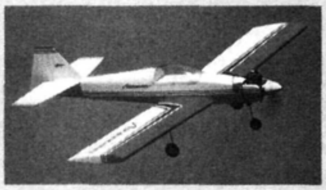
The initial nose-gear setup produced a forward "raked" attitude on the ground. This required more than the usual elevator input to get the airplane airborne on takeoff or touch and go. Readjusting the nose gear corrected this.

• LOW-SPEED FLIGHT

The model required about 2 degrees of left aileron trim to maintain straight and level flight. No other trim inputs were required. Normal "cruise" flight required 50-percent power or less with the Enya 54. The model does not stall in the classic sense. At full-elevator input and idle power, it turns slowly to the left and loses altitude very slowly, with no tendency to "fall off" on a wing, or enter a spin.

• HIGH-SPEED FLIGHT AND AEROBATICS

The model is somewhat sluggish in the roll axis. This is particularly noticeable when attempting to roll out of a steep-banked turn but sufficient to accomplish the full spectrum of standard aerobatics. Pitch-and-yaw control is very good, with enough authority to accomplish snaps, spins, stall turns and knife-edge flight.



I sealed the gaps between the ailerons and the wing. This reduced the roll trim to zero and dramatically increased the roll rate from 3 seconds per revolution to less than ½ second per revolution.

I flew inside and outside loops, axial, barrel and slow rolls, snap rolls, spins—all with recovery "hands-off." In knife-edge flight, the model had a slight tendency to track away from the pilot and climb slightly at full power. The model flies inverted as well as it does right-side up, including slow flight, 360s and outside loops. When inverted, it requires little elevator input to maintain level flight.

SPECIFICATIONS

Name: Advance 40 VRTF

Type: sport

Manufacturer: Hangar 9

Wingspan: 60 in.

Fuselage length: 50 in.

Wing area: 664 sq. in.

Flying weight: 5 lb., 14 oz.

Rec'd engine: .40 to .48 2-stroke

Engine used: Enya .54 4-stroke

Propeller: APC* 11x7

Radio req'd: 4-channel with four standard servos

Radio used: Airtronics* Quasar

Street price: $169.95

Features: modularly constructed balsa and plywood, finished in Ultracote* covering. The easy-to-understand, 7-stage instruction manual allows quick assembly using nicely detailed photographs and drawings.

Comments: a well-designed, very complete, easy-to-assemble plane that will go from slow flight for the graduating trainer pilot to aerobatics for a veteran who wants some fun.

Hits
- Wide performance envelope.
- Excellent hand-built construction.
- Well-done Ultracote covering and trim.
- Very complete kit.

Misses
- Gaps between aileron and wing should be sealed for better performance.

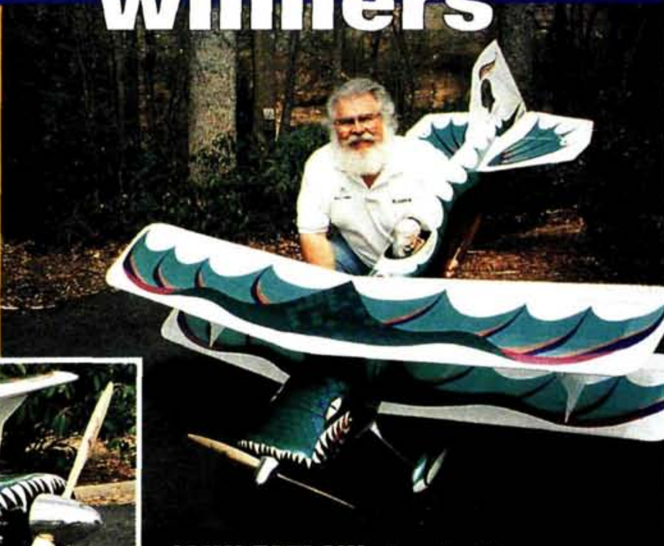
MONOKOTE DESIGN CONTEST winners

Champion color schemes

We at *Model Airplane News* and the folks at Top Flite appreciated the response to the "Cover like a Champion" MonoKote contest. Top Flite writes, "This was a difficult contest for us to judge because, of the hundreds of entries we received, so many of them could have been winners. The time spent in trimming the planes and the dedication to scale design made many of these designs works of art. We were especially thrilled to receive so many entries from modelers ages 13 to 18. It is encouraging for us to see so many young people interested in the hobby.

"Our thanks to all of you for your participation, and we thank you for the many comments about MonoKote and why you like using it. Don't be surprised to see yourself and your plane in an ad one day!"

1



JOHN ESTLOW *Danville, VA*

John Estlow, who won a Top Flite Giant Corsair kit, a US Engines 41cc, a Futaba 6XA radio and MonoKote insignia and covering, writes, "MonoKote brings out my creativity with dazzling colors, ease of application, strength and light weight. Why would I use anything else? I love MonoKote!"

2

RAIKO POTTER *Fairhope, AL*

Quips Raiko Potter, winner of 50 rolls of MonoKote: "To MonoKote or not to MonoKote? There is no question!" He also adds that he has been using MonoKote ever since he soloed his first trainer back in 1987.

3

BOB MCDOUGALL *Kennewick, WA*

Bob McDougall won 15 rolls of MonoKote, and SmartStripe and Woodpecker tools. He built this model for fellow club member and IMAC competitor Rob Opgenorth. He notes, "I've tried many varieties of iron-ons, but I keep coming back to MonoKote for its ease of use, excellent color selection and ready availability."

PROFESSIONAL FINISH WINNERS

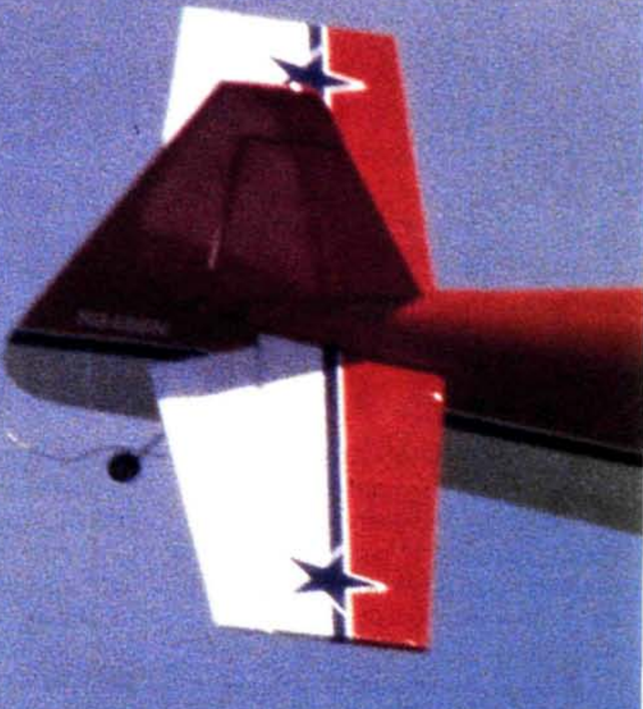
Joe Adamo, Souderton, PA
Luiz Antonio Pereira, Pouso Alegre, MG, Brazil
Scott Barnes, Berwick, PA
Bob Barczynski, Marion, IN
Charles W. Bobbitt, Madill, OK
Ted Carl, Wayzata, MN
Scott Clark, Belleville, IL
William W. Dupuis III, Orlando, FL
Carl Engel, age 14, Clear Lake, WI
William Johnson, Jacksonville, AR
Rudolph Krasensky, Czech Republic
Peter Mularchuk, Union Beach, NJ
Harold M. Mulligan, North Las Vegas, NV
Dennis Noble, age 17, Bellevue, WA
Lee Richter, New Berlin, WI
Wilson Roque, Caracas, Venezuela
Paul and Oliver (age 15) Rorive, Wichita Falls, TX
Mark Schaff, Parker, CO
Richard Thomas, North Wales, Great Britain
David Twelves, age 15, Stuart, FL
Lee B. Van Tassle, APO Okinawa, Japan

(Each received a 5-roll MonoKote assortment, a Top Flite Cool Hand covering glove, Aluminum Polish and Foaming Model Cleaner.)

A 1/5-scale high-performance aerobat

by Rich Uravitch

MODEL AIRPLANE NEWS
CONSTRUCTION



THE DR-109 IS THE newest, full-scale aerobatic offering of Dan Rihn, the same former Pitts driver who gave us the DR-107. Also known as the "One Design," this bulldog-looking, single-place aerobat that promised to provide a mount for the competition-prone pilot who wasn't prepared to mortgage his life to "enter the box" in a pricey, high-powered monoplane like the Extra, CAP, Giles, or Staudacher. The idea behind the One Design concept was to design an aerobatic machine that would use a standard Lycoming 0-320, 160hp engine, would be made out of conventional materials and could be built in a home workshop. I was so impressed with the full-scale version that I designed a ⅕-scale model that was presented right here in *Model Airplane News* in the April '98 issue. That model delivered everything I wanted it to and remains a really fun airplane to fly. Not content to live on past laurels, Dan "stretched" the One Design to accommodate two aviators. Its length and span are larger, the cockpit is a bit roomier, and the flying qualities are a bit smoother. The airplane is not simply a two-place One Design but much more, both in size and refinement. Following his lead, and looking for the same differences, I designed the model DR-109 seen here. It is true ⅕ scale and was drawn from a 3-view provided by Dan, so it's a natural for MINIMAC and sport-scale competition. Otherwise, just fly it for fun! Over and above the size difference in the models, the DR-109 wing uses a 16-percent, fully symmetrical airfoil, and the aft section of the fuselage is built up with longerons and stringers instead of sheet wood sides. In addition to a significant weight savings, the torsional strength is considerably greater. This approach was taken specifically to reduce weight as a means to improve performance. The result? Despite its being nearly 15 percent larger than my One Design, the DR-109's weight and wing loading is about the same: a very comfortable 22.4 ounces per square foot!

I have every hope that you will be impressed with the capabilities of this compact but smooth flying aerobatic package. Fellow fliers who see the model fly for the first time are impressed with its crisp and responsive qualities. I designed it to accept any 2- or 4-stroke engine from .40 to .70 displacement and, although I fully expect some modelers will put .60 2-strokes in the nose, it's simply not necessary. The final version shown here is powered by an O.S.* .46FX engine fitted with a Bisson* Pitts-style muffler and an 11x7 APC* prop. The model's all-up (dry) weight is 85 ounces, which allows sprightly climb performance. The model is an easy build that will introduce some—and reacquaint others—to longeron and stringer construction. Follow me through the building sequence; I hope you'll be convinced to give it a try!

BUILDING SEQUENCE

The airframe will go together quickly once you familiarize yourself with the sequence and supporting photos. Before starting, a few helpful notes are in order. The parts template sheet shows all the fuselage bulkheads in halves. There are a number of reasons for this, but the most important is that if you stack-cut the pieces, you will always end up with symmetrical parts, and this makes it easier to build a truer airframe. It also conserves wood by allowing you to use standard-width materials. Each pair of bulkhead halves is joined and then reinforced with a piece of ½x⅛ lite-ply spanning the width of the bulkhead. This adds tremendously to the strength of the

DR-109
THE NEWEST ONE DESIGN

SPECIFICATIONS

Model name: DR-109

Type: sport-scale aerobat

Length: 49 in.

Wingspan: 54.5 in.

Wing area: 552 sq. in.

Weight: 78 to 88 oz.

Wing loading: 20.3 oz./sq. ft. (at 78 oz.); 22.9 oz./sq. ft. (at 88 oz.)

Airfoil type: symmetrical, RAU16

Power recommended: .40 to .50 2-stroke or .48 to .70 4-stroke

No. of channels req'd: 4

Recommended initial control throws (from neutral):

Aileron: 3/16 inch up and down

Elevator: 1/4 inch up and down

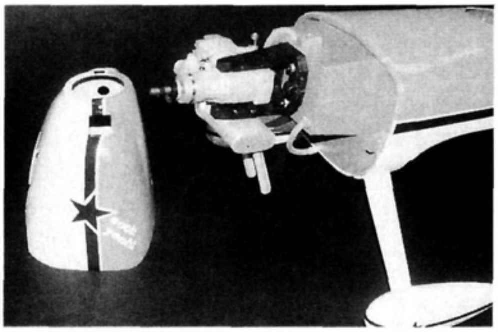
Rudder: 1/2 inch left and right

Prices for parts from Rich Uravitch: $29.95 plus $1 S&H (plastic parts package); $10.95 plus $3 S&H (formed aluminum gear); $24.95 plus $3 S&H (fiberglass cowl).

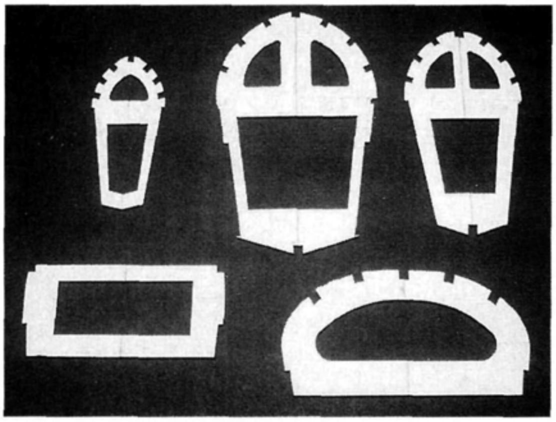
Hobby Hangar laser-cut parts set: $35

Comments: designed by Rich Uravitch, the DR-109 is 15 percent larger than Rich's popular One Design model, uses a 16-percent, fully symmetrical airfoil, and the aft section of the fuselage is built up with longerons and stringers for significant weight savings and greater torsional strength. The MINIMAC-legal model has crisp and responsive flight characteristics and can be powered by any 2- or 4-stroke engine from .40 to .70 displacement.

PHOTOS BY RICH URAVITCH

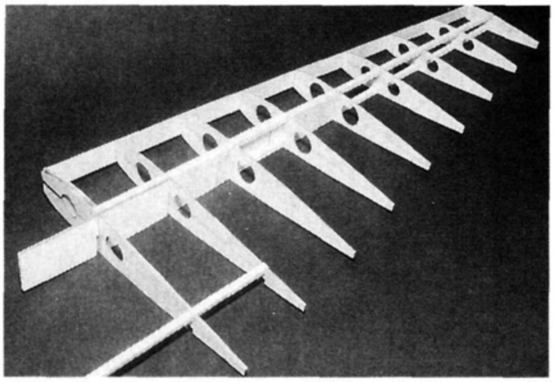


The DR-109 has plenty of room under the cowl for a variety of engines; note the Bisson Pitts-style muffler.



Stack-cut the bulkheads, then join the halves at the centerline and reinforce the joint with strips of lite-ply positioned across the width of the bulkhead.

finished part. I suggest you cut out all the parts first, making your own "kit," then join the bulkhead halves and add the reinforcing strips. Be sure to transfer all the guidelines and alignment marks shown on the template sheet to the parts; this will help ensure an accurate, twist-free structure.

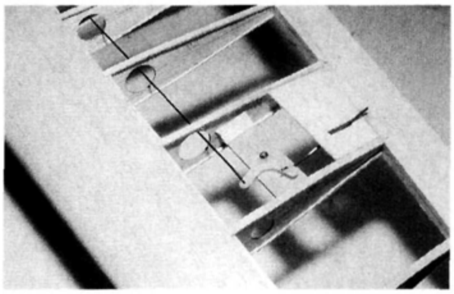


Upper spar, sub LE and vertical spar webbing have been installed. Wing joiner WJ has been temporarily fitted.

Although the wing uses a symmetrical section, I suggest that you build the panels inverted over the plan. This will allow the root rib (W1) to be installed at an accurate 90 degrees to the building surface by using a simple square or triangle. When the wing panels are joined (also while inverted), they will exactly match the required dihedral effect automatically produced by the tapering thickness.

Construction starts with the wing and proceeds as follows:

1. Protect the plan by covering it with wax paper or clear film.
2. Pin the 1/4x1/4-inch balsa temporary shims in place over the plan. These will allow the wing panels to be built flat on the plan.
3. Pin a 1/4x1/4 spar in place over the plan. Add ribs W2 through W9, ensuring that each is perpendicular to the building surface.
4. Add the 1/16 balsa sub leading edge (LE), aligning the vertical marks with each of the ribs.
5. Prepare the W1 rib assemblies by laminating a W1A riblet to the W1 rib. Make a left and right assembly. Install rib assembly W1 at the indicated location, making certain it is perpendicular to the building surface.
6. Draw a centerline (CL) on the trailing edge (TE) where the ribs will attach. Install the TE, centering the line you have just drawn on the CL of each rib. There will be 1/16 spaces above and below the rib to accept the capstrips.
7. Add the 1/16 balsa LE sheeting. Do not install the center-section sheeting (aft of the spar) at this time.
8. Install 1/16x1/4 balsa capstrips on ribs W3 through W9.
9. Remove the wing panel from the building surface, invert it, and pin it back in place over the plan, making sure it is supported by the temporary shims.
10. Add the upper 1/4x1/4 spar.
11. Install the LE sheeting.
12. Install all the 3/32 balsa shear webbing between the spars from W2 through W5. The grain of the webbing is vertically oriented. Fit these webs carefully to ensure contact between the spars and the ribs; this strengthens the wing significantly.
13. Install 1/8 lite-ply gussets on the outboard side of rib W4 where it joins the TE.
14. Install 1/8 plywood aileron bellcrank mounts between ribs W5 and W6. Fit bellcranks, wire and other aileron linkage parts at this time.
15. Cut all 1/16x1/4 balsa capstrips to length and glue in place.
16. Add 1/2x1 balsa LE and wingtip blocks; carve and sand to contour. Use a sanding block to ensure uniformity of cross-section.
17. Repeat steps 1 through 16 to build the opposite wing panel.
18. Join the wing panels with slow-cure epoxy. To ensure perfect alignment, two short lengths of 1/4-inch dowel may be used in the holes in W1. Note: the wing has no dihedral other than that generated by its thickness/taper. For this reason, before the epoxy has cured, invert the joined panels and weight them sufficiently



The right-hand wing panel with bellcrank plate and aileron linkage installed. Add scrap blocks to fixed portion of TE if Robart* hinges are used; this provides more anchor surface for the point of the hinge.

to ensure that the upper surface contacts the building surface. Make sure the temporary 1/4x1/4 shims are still in place.

19. After the epoxy has fully cured, remove the wing from the plan and install 1/8 lite-ply WJ.
and WJR joiners using slow-cure epoxy.
20. Install ribs W1B to form aileron servo compartment. Add 1/4x1/4 auxiliary spars and scrap fill made out of aileron stock.
21. Add all remaining 1/16 balsa sheeting to center section from spar aft.
22. Wrap center joint with 3-inch fiberglass tape/cloth bonded with resin or Zap*.
23. Using epoxy, install 1/4-inch hardwood dowel through LE into slot in rib W1.
24. Mark outline of aileron on TE stock. Carefully cut out and remove aileron portion. Sand LE of aileron to a constant radius. Temporarily fit and install hinges of your choice.
25. Sand entire wing to remove any imperfections.

FUSELAGE CONSTRUCTION SEQUENCE

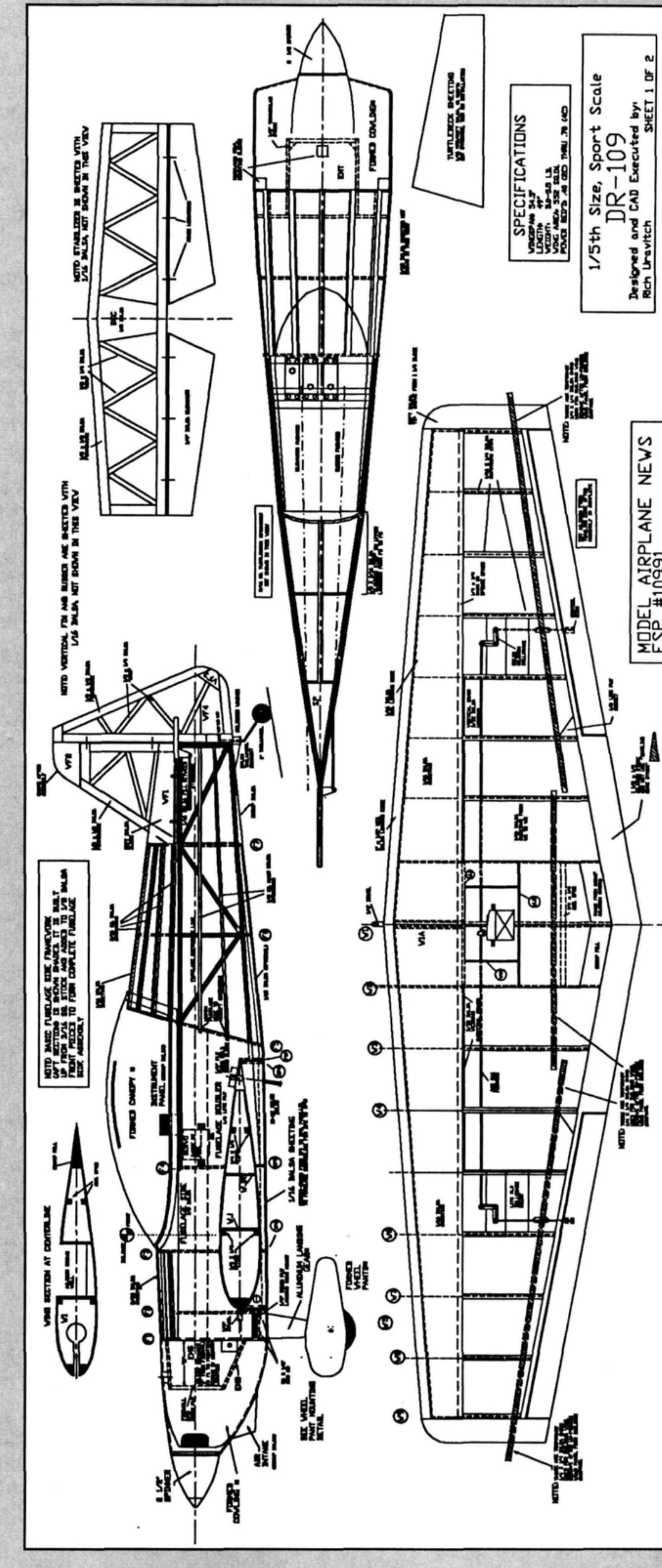
Prepare bulkheads F2 through F7 by joining them at the CL and reinforcing them across the width of the bulkhead with 1/2-inch-wide strips of 1/8 lite-ply. The reinforcement of F1 should be vertical, on the join line, on the rear face. Crosswise stiffness will result from the attachment of the engine mount "box."

1. Begin construction of the fuselage by building a pair of aft section assemblies. These are made out of 3/16x3/16 balsa frames built directly over the shaded portion of the plan. They consist of upper and lower longerons, vertical and diagonal members.
2. Prepare a left and a right forward fuselage side by laminating an 1/8 lite-ply doubler to the 1/8 balsa fuselage side. Use Zap or epoxy, not contact cement.

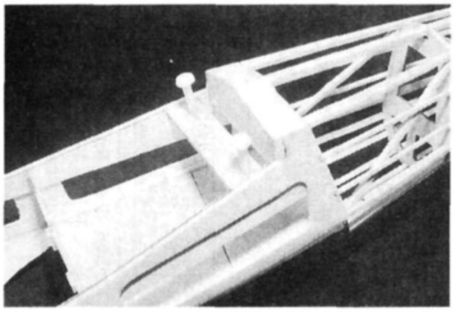
3. Join the aft section assembly to the forward section. The aft section assembly is glued to the inside surface of the forward section. Make sure to make a left- and right-hand part.
4. Glue bulkheads F1 through F5 to the right-hand fuselage side, ensuring each is on the marked position and on the fuselage reference line. Extra attention must be paid here to ensure a twist-free fuselage.
5. Add the left-hand fuselage side, but before permanently gluing it, temporarily tape the rear ends of the fuselage sides (tailposts) together so they're aligned exactly with each other.
6. Add bulkheads F6 and F7.
7. Add 3⁄32 balsa stabilizer platform and cockpit floor between fuselage sides at locations marked on plan.
8. Add the 1⁄4x1⁄4 hard-balsa stringers from F1 to F3.
9. Add aft (turtle deck) 3⁄16x3⁄16 stringers between F5 and F7.
10. Block-sand the stringered areas to provide a smooth contour to which the medium/soft balsa sheeting may be attached.
11. Add all upper balsa sheeting. Wetting the outside surface will allow it to more easily conform to the shape of the formers. This will be especially necessary in the area forward of the cockpit and includes the fuselage sides in that area.
12. Sand the surfaces to blend all the joints.
13. Cutting along the line indicated on the plan, remove the sheeting from the cockpit section of the fuselage.
14. Install the 1⁄4-inch birch-ply landing gear and wing hold-down plates using a liberal application of slow-cure epoxy.
15. Reinforce the landing-gear plate installation with scrap balsa stock.
16. Fit and temporarily install the aluminum landing gear with three, 1⁄2-inch no. 6 sheet-metal screws.
17. Fuelproof the interior of the fuselage from the F1 to F3 with resin.
18. Add the 3⁄32 balsa lower sheeting in the landing-gear area up to the aluminum gear. The section between the gear legs will be sheeted later.
19. Add rear filler pieces that extend from F7 to the tail post. This is where rudder and elevator pushrods exit the fuselage.
20. Add 1⁄8 balsa "blending strips" to longerons between F5 and F6. Block-sand to blend fuselage side to longeron.

JOINING THE WING TO THE FUSELAGE

Be sure to check wing/fuselage alignment and symmetry before drilling holes.
1. Position the wing in the fuselage cutout and temporarily secure it with pins, tape, or clamps after aligning its CL with that of the fuselage.
2. Drill a 1⁄16-inch pilot hole through the TE of the wing and the 1⁄4-inch birch-ply attachment plate in the fuselage.



FSP10991— TO ORDER THE FULL-SIZE PLAN, SEE PAGE 136 OR CALL (800) 537-5874



The fuselage is lightweight yet strong, the aft portion is built up construction.

3. Remove the wing from the fuselage, redrill the pilot holes, and install the two 10-32 blind nuts in the upper surface of the attachment plate. Alternatively, the ply mount plate may be tapped 10-32 and the threaded holes "hardened" with Zap. Glue two 1/8 lite-ply discs ("washers") in place over the holes on the bottom surface of the TE. These will prevent the bolts from crushing the surrounding balsa.
4. Attach the wing to the fuselage using two 10-32 nylon bolts.
5. Add formers BP1 through BP4 to lower wing surface.
6. Add 1/4x1/4 center stringer and all 3/32 balsa sheeting, including the side pieces. The grain of the sheeting from BP2 to BP4 should be parallel to the fuselage CL. It should be cross-grain from BP1 to BP2 to facilitate bending. Sand wing to fuselage joint to blend surfaces. Drill holes in lower skin to access 10-32 nylon bolts and remove wing from fuselage.

TAIL GROUP PREPARATION

1. The vertical fin, rudder and horizontal stabilizer are all built up using 1/8x1/2 strip balsa, 1/8x1/8 square balsa and parts SCC, VF1, VF2, VF3 and VF4. They are built directly over the plan. After all the framework is assembled, 1/16-balsa sheeting is applied to each side of the framework.

If you'd prefer to save some additional weight in the aft end of your DR-109, the 1/8x1/2 and 1/8x3/16 can be replaced with 1/4x1/2 and 1/4x1/4, and the balsa sheeting can be omitted. The open framework would then be covered with iron-on film covering.

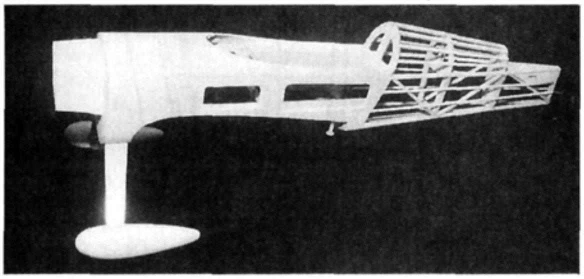
2. Embed an 1/8 lite-ply insert into one elevator half as shown on plan. It should be installed flush with the surface to which the control horn will be attached; the "thickness gap" on the opposite side of the control surface should be filled with scrap balsa and sanded flush.
3. Join the elevator halves with a 3/32 wire joiner.
4. Round all the edges of the tail group by carefully sanding to a CL drawn around the edge of the part.
5. Temporarily fit and install hinges of your choice.

FINAL ASSEMBLY

1. Temporarily attach the fin and horizontal stabilizer. Add soft balsa blocks to the rear of F7 to form fairings between vertical fin and stabilizer. Carve and sand to final shape. Remove fin and stabilizer until after they have been covered.
2. Make a tailwheel strut assembly using a nylon bracket as shown, or by inserting a length of 3/32-inch music wire into a nylon aileron bearing, bending the wire to form the strut and cutting a slot in the aft end of the fuselage to accept the bearing. Remove assembly until the covering has been completed.
3. Shape a piece of 1/4-inch scrap balsa to fill the gap between the rear edge of the vertical fin and the fuselage. This piece will be installed later, after the stabilizer/elevator has been installed but before the rudder is permanently attached.

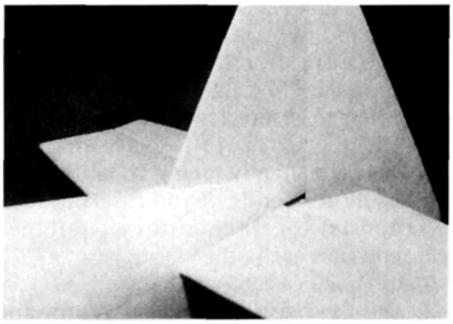
ENGINE INSTALLATION

The F1 former is located sufficiently far aft to allow the model to accept nearly any engine size or configuration. The space from F1 to the engine drive washer is determined by the length of the submount (box) you make, tailored to your engine installation. The "box" is made of parts EMS (two), EMT and EMB. Bolt the engine to the mount of your choice, position it over the plan and mark its location. Adjust the firewall to F1 dimension ("X") of the EM parts to suit your particular installation. Assemble and trial-fit the vacuum-formed cowl. The three hardwood cowl attachment blocks should now be added to the firewall. Recess them about 1/16 inch from the edge of the fuselage to allow for cowl thickness, and attach the cowl with three wood or sheet-metal screws. For additional durability, add three pieces of scrap ply to the inside surface of the cowl where the mounting screws will be. If you decide to add these reinforcements, be sure to offset the hardwood mounting blocks accordingly.



The forward upper sheeting is in place and has been sanded to a smooth contour. The 1/16 balsa turtle-deck sheeting has not yet been installed.

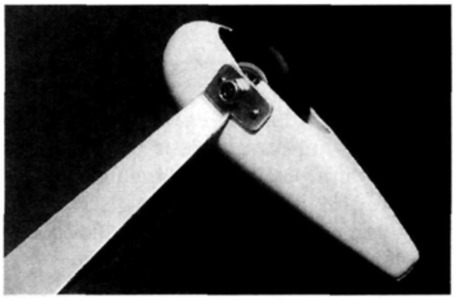
The cowl butts up to the fuselage; it does not go over it. However, sufficient excess material is provided on the molded cowl halves to allow you to trim the rear edge a little wider to permit the cowl to slide over the fuselage. If you choose to go this way, remember not to widen the spinner end of the cowl also. The trim line will now go diagonally from front to back of the cowl, allowing the spinner to match at the front and the rear to slide over the fuselage. Some filler will be required on the low portions of the joint.



Soft balsa blocks, carved and sanded to shape, are used to blend the turtle deck into the fin and horizontal stabilizer.

FINAL PREPARATION

In preparation for covering, fill any dings or imperfections with HobbyLite, MicroFill, or similar putty. Final-sand all the wood surfaces. Temporarily install all the control linkages and radio equipment as well as hinges and any other accessories. When you're satisfied with all the installations, cover your DR-109 with your favorite material. Our prototypes were finished with Ultracote*, MonoKote* and Oracover*; they all yielded fine results. When the covering is complete, add the pilot figure, canopy and any other details you choose. Your model's all-up dry weight should be between 78 and 88 ounces. Balance your model in pitch at the location shown on the plan. This CG location is very conservative, and you will likely want to move it aft as you gain more flying experience. Feel free to do so (up to 1/2 inch is still acceptable). The feel will be decidedly "snappier" in pitch but not unmanageable for the experienced flier. After checking the CG, check the balance in roll also. The model should show



Wheel-pant attachment detail. A small screw through aluminum landing gear into ply reinforcement inside the pant half ensures a very durable installation.

no tendency to drop a wing. If it does, add the necessary weight to the light wingtip.

Reassemble all the major components of the model. Make certain that the stabilizer and vertical fin are square to the fuselage before you epoxy them in place. Remember to remove any film covering from surfaces to be joined. Join the elevator halves with the 3/32 music-wire joiner and hinge to stabilizer. Now is the time to install that little 1/4-inch balsa filler piece you so handily shaped in Step 3 of the "Preliminary Assembly" section. Permanently install the landing gear, sheet the lower area with 3/32 balsa and cover it.

RADIO INSTALLATION

Nothing terribly complicated here. Use either solid spruce pushrods or Nyrod to the elevator and rudder; cable/conduit to the throttle. If you use Nyrod, make certain that the conduit tube is anchored securely to the structure. For roll control, you may prefer to use individual mini-servos to drive each of the ailerons. For years now, I have used the pushrod/bellcrank arrangement shown with no difficulties; just be sure that there is no slop in the system. I positioned the battery pack aft of the servos, against bulkhead F-3, to provide the CG that I wanted.

FLYING THE DR-109

In spite of its size, the DR-109 is a high-performance model. If you're comfortable flying a moderate-performance .40-powered model, the DR-109 will deliver all that you ask of it for a fraction of the price of some larger models while offering a change from the large assortment of Lasers, Extras and CAPs.

I hope you enjoy it. If so, tell your friends; if not, tell me. Your comments are important. While you're waiting for the glue to dry, I'd like to invite you to visit my website at www.RichUravitch.com.

A plastic parts package for the DR-109, along with other accessories, is available directly from me. It consists of a clear canopy, plastic cowl and wheel pants and an instruction sheet. I also have preformed aluminum landing gear and fiberglass replacement cowls. Send orders directly to Rich Uravitch, 948 Falconer St. N.W., Palm Bay, FL 32907; phone/fax (407) 728-0486; email: AEROSCALE@aol.com. To speed up the building process, I have made arrangements with Hobby Hangar* to provide a laser-cut parts package for the required cut parts. To this you would only need to add stock-size sheeting and stringer/spar stock. It couldn't be easier to "plans-build"!

*Addresses are listed alphabetically in the Index of Manufacturers on page 142.

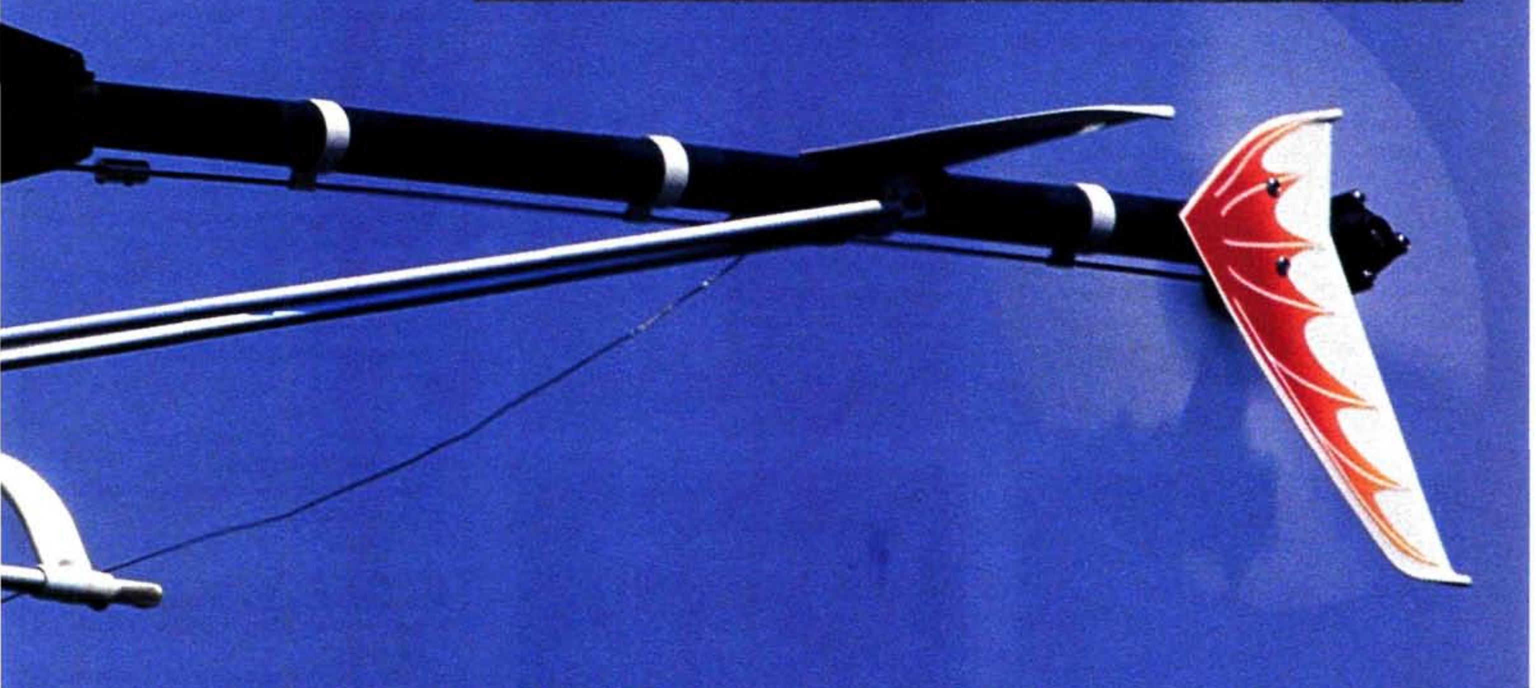
A few people at my flying field have asked me to recommend a good, inexpensive entry-level heli that will allow them to grow past the hovering stage. I had heard that the new .30-size Thunder Tiger* Raptor was relatively inexpensive, a nice flier and easy to maintain, so I decided to check it out. The almost-ready-to-fly Raptor is available with or without a Thunder Tiger .36 ABC engine and with 29 ball bearings (a 20-ball-bearing upgrade kit is available).

The helicopter comes as three main components: the main body with engine, fuel tank and rotor head installed; the tail boom with tail-rotor assembly, belt, fins and struts installed; and the canopy with a windshield that has to be installed. Also included are the completely weighted and covered main blades, a bag of control-surface linkages, decals, a manual and a few pieces of hardware needed to complete the assembly.

THUNDER TIGER Raptor ARF

by Dan Lynch

PHOTOS BY WALTER SIDAS



From hover to hot-dog, this .30-size chopper will suit your flying skills

PUTTING IT TOGETHER

First attach the tail boom to the main body. All you have to do is twist the belt ¼ turn the proper way, insert the tail boom, put the belt over the gear, pull the tail boom out until the belt has no more than 5mm of play, then tighten the housing around the boom to secure it. It's that easy and quick. While you adjust the fin and supports, you may want to have the screws that hold the tail-boom supports on the horizontal fin support loosened because the screws may dig into the tail boom and scrape it. After I had slid the plastic pushrod guides onto the tail boom, I put electrical tape on both sides of the rings to keep them in place. Now it almost looks like a helicopter; all you need is the canopy.

Basically, you have to cut the bubble off the white canopy and attach the windshield. I found this time-consuming, and I ended up attaching the windshield with R/C car plastic rivets instead of the supplied screws because I thought that they would hold better. Thunder Tiger's directions don't mention cutting a hole for the on/off switch on the right side of the windshield, but a photo on the box confirmed that I had to cut it. I also had to trim off the excess flashing.

Before you apply the decals, clean the canopy with rubbing alcohol. I had some trouble fitting the decal into the on/off switch cutout (the manual tells you to slice the decal to wrap it into the cutout). Next time, I would simply cut out that part of the decal.

FLIGHT PERFORMANCE

I set the Raptor up according to the manual. The collective arm comes with two positions for the servo link: the outer hole is for general-purpose flying, and the inner is for advanced flying. I used the inner hole on the collective arm and adjusted the pitch range using a JR 8103 computer radio for general flying in normal mode and advanced flying in stunt-mode 1. Total collective range used was from +11 to -9 degrees.

For the first few flights, I treated the engine to rich mixtures and light loads using 15-percent heli fuel with some castor in it. Tracking was perfect out of the box, and the top end of the pitch curve needed only minor tweaking. Other machines seem to break in all of the moving parts during the first few flights. This model spun down after its first flight as though it had been flying all season.

• GENERAL FLYING

When the engine had some time on it, I pushed the model a bit harder. Its vertical acceleration is as good as that of any .30-size machine on the market. Forward flight characteristics are excellent, with no tendency to pitch up or down in high-speed flight. Tail authority is good, and the Raptor is smooth through its flight transitions.

• AEROBATICS

Compared with other stock (unmodified) helis, the Raptor stands out as a star in its price range. It has remarkable pitch rates and performance features that other helis would need upgrade parts to achieve.

The Raptor loops and rolls smoothly. The roll rates need to be maxed out to achieve a truly brisk roll. Initial tumbles seemed to be more like loops, but after I had increased the fore and aft cyclic rates, the tumbles were tighter. Inverted flight requires better throttle-to-pitch-curve mixing. After I had adjusted the radio, inverted flight was a breeze—no bad tendencies. Tail authority was strong, and the Raptor pirouettes quickly. For 3D flying, the manual recommends +12 and −8 degrees pitch range; this is a fair place to start. If you use a longer servo arm on collective, you can achieve a greater pitch range.

• AUTOROTATIONS

The Raptor does outstanding autorotations that rival those of a .60-size machine. Most .30-size machines don't have enough rotor inertia to give you a reasonable (read: comfortable) margin of error. The Raptor makes it easy to practice autorotations, and few .30-size machines make you this confident.

SPECIFICATIONS

Model: Raptor

Type: .30-size heli

Manufacturer: Thunder Tiger

Weight equipped: 6.25 lb.

Rotor span: 49 in.

Tail-rotor diameter: 9 in.

Length: 43.5 in.

Height: 15.7 in.

Gear ratio: 1:9.56:4.56 main rotor/engine/tail

Engine rec.: .32 to .36

Engine used: Thunder Tiger .36 ABC (already installed)

Radio used: JR 8103, four JR 531 servos, one JR 4131 servo, FMA receiver (1100mAh battery)

Gyro used: Futaba 153BB

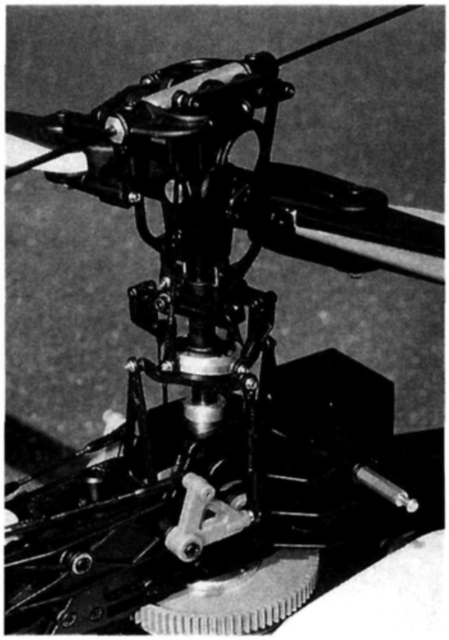
List prices: $399.99 (29-ball-bearing ARF with .36 engine); $279.99 (without engine); $28.99 (20-ball-bearing upgrade)

Features: this ARF helicopter is a high-quality machine that comes with or without a .36 ABC engine installed. The fuel tank, rotor head, tail boom with tail rotor, and belt, fins and struts are factory-installed. The Raptor also comes with a windshield and weighted and covered main blades, a bag of control-surface linkages, decals, a manual and a few pieces of hardware.

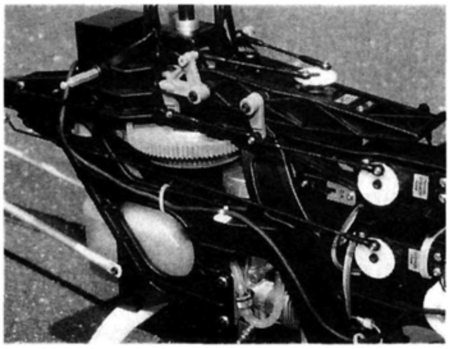
Comments: the great thing about this helicopter is that it can be docile for beginners, yet it's agile enough to allow advanced fliers to practice 3D maneuvers.

Hits
- Great machine that can "grow" with your piloting abilities.
- Silky-smooth hovering characteristics.
- 3D capabilities.
- Low cost.

Misses
- Insufficient setup instructions.
- Built-in pitch gauge does not match manual.
- Canopy requires a lot of preparation.



The Raptor's rotor head comes assembled and attached to the main shaft. Control response is smooth.



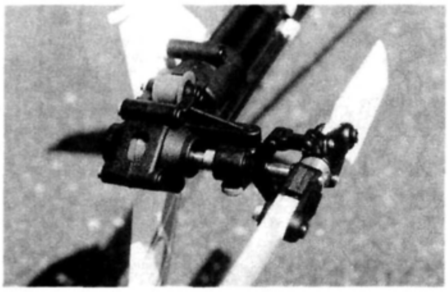
The molded plastic side frames are strong and well-designed. Note the belt-drive arrangement.

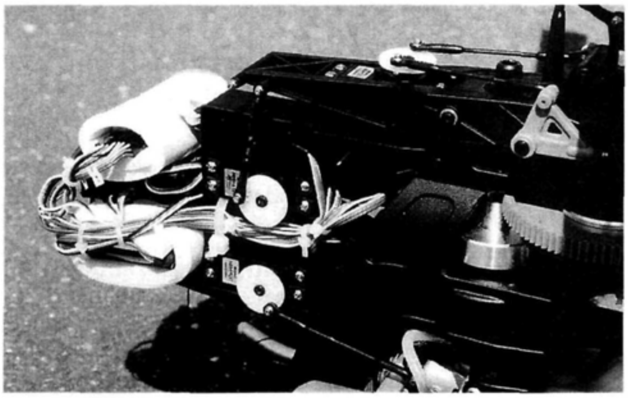
INSTALLING THE ELECTRONICS

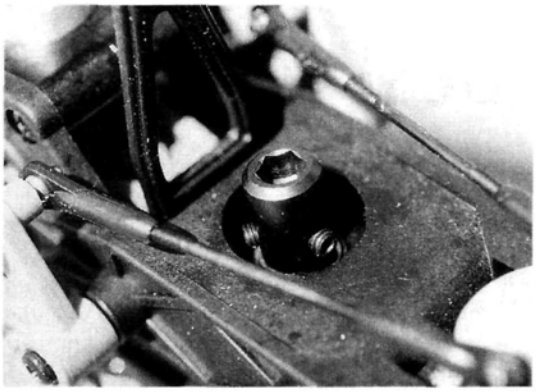
To keep costs down while still ensuring that the model will be safe to fly, I used four 50 oz.-in. servos for throttle, tail rotor, forward/aft cyclic and right/left cyclic and one 90 oz.-in. torque servo for collective. Installing the servos was straightforward. The manual tells you which servo arm to use if you use JR* or Futaba* equipment (I used JR).

There are no Z-bends in this model; they are all ball links. Thunder Tiger even added a nice mount for the on/off switch. Installing the gyro was quite simple. It sits behind the main shaft on a shelf and is attached with double-sided tape. The gyro wire runs down the outside of the frame and is secured with tie-wraps and a wire holder. The battery, receiver, gyro on/off switch and amplifier all sit on another shelf that's at the front of the main body.

The next step is to add the linkages that run from the servos to the control







Top: the tail rotor comes assembled and attached. Make sure that you twist the drive belt a a quarter of a turn in the correct direction while holding the tail boom. Above left: the RX, battery and gyro are attached to the shelf in front of the main frame—typical design layout. Above right: to start the engine, insert the starting wand into this flex-nut fitting.

Ball-bearing Upgrade

It was fairly easy to add the 20 additional ball bearings to the Raptor. They replace 20 bushings in the following:

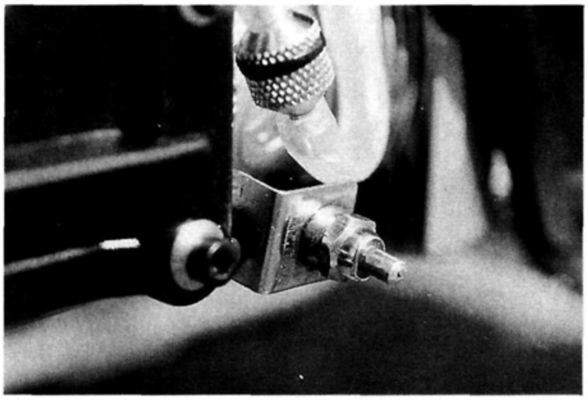
- flybar control arms on the washout assembly—4
- aileron control levers—4
- elevator control lever—2
- collective pitch arm—2
- mixing arms on the seesaw hub—4
- main rotor hub where the seesaw hub pivots—2
- tail-pitch control lever—2

My only problem came when I removed the bushings from the main rotor hub, which is where the flybar seesaw hub rests. I initially tried to pry them out with a little pressure, but I found that taking a screw with a head that wouldn't slide through the bushing but would fit through the housing loosened the bushing; then I pulled it out with a pair of pliers.

After the upgrade, I didn't immediately notice any improvement in the Raptor's performance; however, I'm sure that with time, the bushings would have developed some slop. This upgrade will ensure long-term performance.

surfaces. I suggest that you use a ball-link tool because it's hard to twist these ball links onto the rods. The manual tells you how long to make each of these linkages.

I turned on the radio, made sure all servo arms were in the proper positions and then snapped on all the control links. If a link was too tight on the ball, I loosened it by gently squeezing it with a pair of needle-nose pliers. Each one should move smoothly on the ball. My only concern was with the tail-rotor pushrod, which is actually two pieces joined by a coupler. I recommend that you create a slight flat on the rods and use Loctite* on the coupler setscrews.



To simplify starting, I added a remote glow-plug igniter.

FINAL TWEAKS

Before installing the main blades, I checked to see whether they were identical in weight and CG points. They weighed the same but the CGs were off. In the manual, Thunder Tiger tells you that it cannot guarantee a matched set; you should buy a blade balancer and follow its directions for blade balancing.

The main frame has a built-in pitch gauge. The manual explains how to use it in great detail, but my model did not match the pitch ranges given in the manual. I had too much positive pitch.

After rechecking the lengths of the linkages, I had to adjust the factory-assembled mixing-arm link, which was 108mm long; I ended up reducing it to 105mm to get enough throw. I gave up on matching the manual's numbers to the pitch gauge and just went for a standard setup to give me full range in stunt mode.

The only thing left to do was to add the remote glow plug (if you don't, you have to take the canopy off to start the engine). I positioned the remote glow plug on the engine mount and added a fuel filter.

To start this heli, you use a 6mm hex shaft, which is not supplied. I initially had trouble keeping the engine running, but after I had adjusted its needle valves, it ran well. All I could say when the Raptor first got off the ground was, "Wow!" I've never seen such a smooth, stable helicopter. The tail was completely still—not one shake. I ran a few tanks of fuel through the engine to break it in while I hovered and tried some forward flight. I adjusted the pitch/throttle curves and set up the throttle hold and revolution mixing (no need to do this if you have a head-locking gyro).

LAST THOUGHTS

The Raptor is a high-quality machine with some great extras: it uses a 10mm hardened main shaft; the flybar has little flats on it for the control-arm setscrews; and the flybar paddles have setscrews that anchor them on the flybar; there's even a little window that allows you to see the tip of the flybar in the paddle. The visible fuel tank is also great.

I thought the manual was a bit challenging for a novice. Although it contained nice "exploded" diagrams, there wasn't much explanation of how to put the heli together.

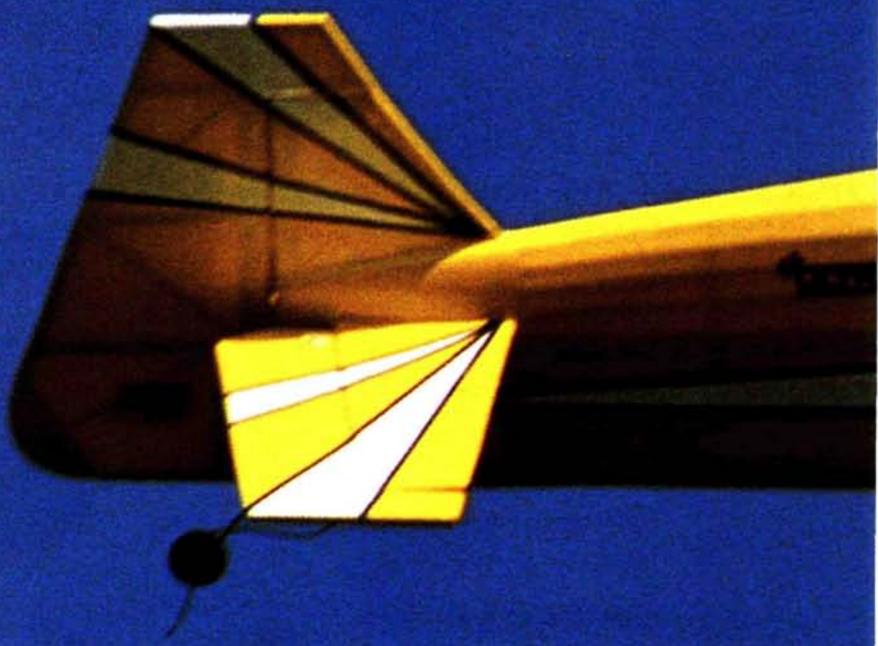
With its low cost, simple design and nice flight characteristics, the Raptor is a definite winner. Its stable hovering characteristics make it ideal for novices and will allow them to advance to 3D maneuvers without having to upgrade to a more sophisticated model.

For the advanced pilot, the Raptor's low cost and 3D capabilities make it a relaxing, enjoyable flying machine. I let a few guys at the field fly it, and everyone commented on how smoothly it hovered. Well done, Thunder Tiger!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

Lanier RC 17.5%

MODEL AIRPLANE NEWS
FIELD & BENCH
REVIEW



by Jim Onorato

IN THE LAST FEW years, aerobatic R/C planes such as Lasers, Extras, CAPs and Giles 202s have proliferated. Most are quite large and may be a bit out of the average Sunday flier's reach. Last year, Lanier RC* introduced a .25-size version of its large Extra—the Extra 3.25—and it was an immediate hit. Now, Lanier has literally halved its 35-percent Giles 202 and come out with the 17.5-percent version of this familiar aerobat.

SPECIFICATIONS

Name: 17.5% Giles 202

Manufacturer: Lanier RC Inc.

Type: scale aerobat

Wingspan: 46 in.

Wing area: 383 sq. in.

Airfoil: symmetrical

Weight: 4 lb., 8 oz.

Wing loading: 27.1 oz./sq. ft.

Length: 41 in.

Radio req'd: 4-channel w/four standard servos

Engine range: .25 to .40 2-stroke or .26 to .40 4-stroke

Engine used: Saito FA-30S 4-stroke w/stock muffler and O.S. .25 FP 2-stroke w/Slimline muffler

Street price: $64.99

Features: built-up construction with laser-cut parts; vacuum-formed clear plastic canopy; formed aluminum landing gear; ABS cowl and wheel pants; full-size, AutoCAD-generated plans.

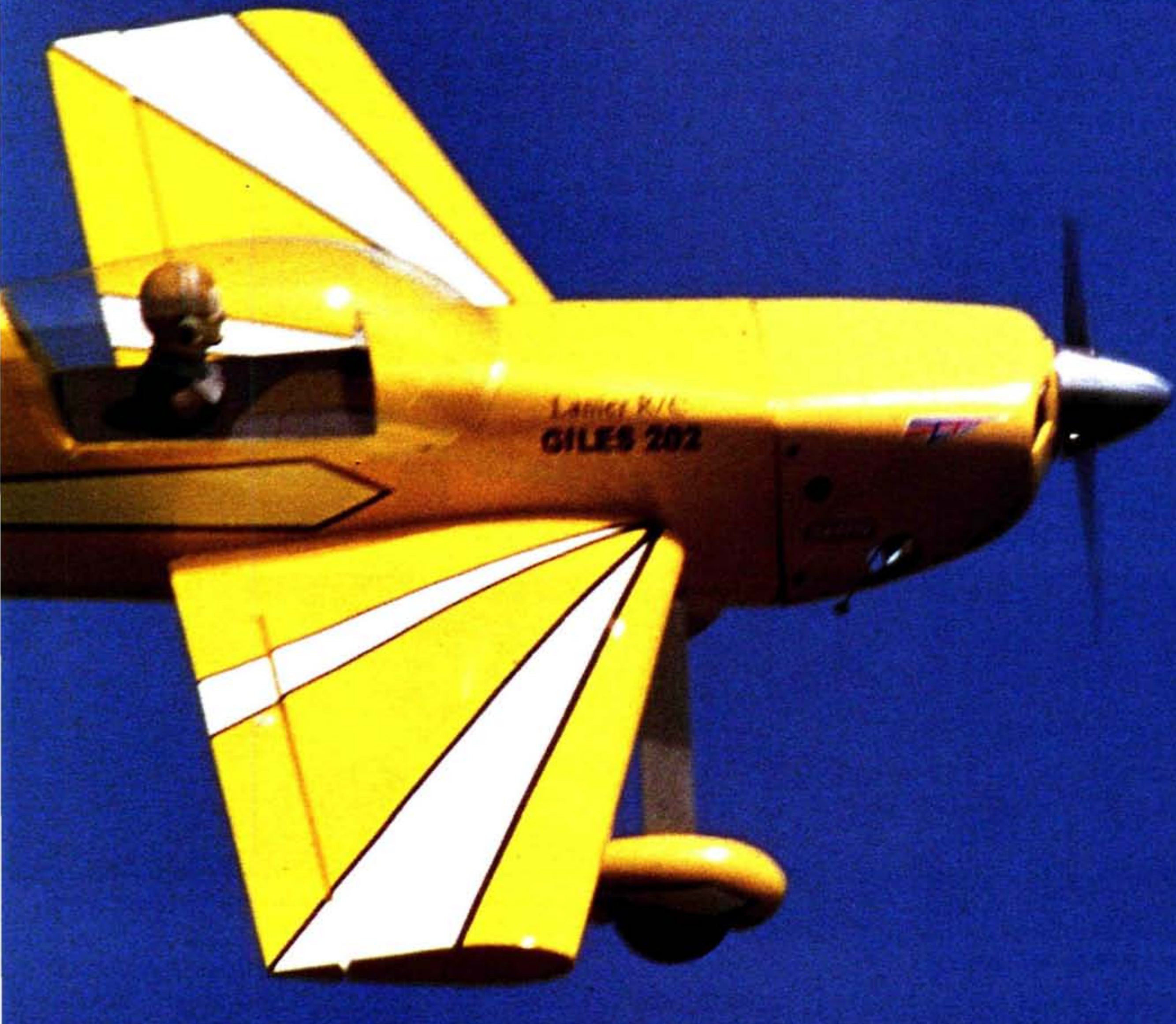
Comments: I enjoyed building and flying this airplane and recommend it to anyone with average building and flying experience.

Hits
- Well-engineered, good-looking model.
- Easy-to-follow plans and photo instructions.
- High-quality, laser-cut parts.

Misses
- Two formers that didn't fit F1-I73 and F66. (These have been replaced in subsequent kits.)
- Weak landing-gear attachment.

GILES 202

A pint-size aerobatic champ!



PHOTOS BY WALTER SIDAS & JIM ONORATO

THE KIT

The 17.5-percent Giles 202, like the Extra 3.25, is part of Lanier's new, All Balsa 21st Century series and features built-up construction with laser-cut parts. Plastic is used only for the canopy, cowl and wheel pants. As with other Lanier kits, hardware isn't included, so you can choose and buy whichever type you like, but the kit does include a complete list of recommended hardware. The plans are CAD-generated, and the 19-page instruction booklet contains step-by-step, written instructions and—a recent addition to Lanier's newer kits—photos.

STARTING CONSTRUCTION

I used Carl Goldberg* Epoxy Plus on the plywood parts and Super Jet* CA on the balsa and plastic parts. Construction starts with the tail feathers; they are built directly over the plans out of ⅛- and ¼-inch balsa stripwood. The procedure is simple and straightforward; nothing very difficult here. I used Easy Hinges* on all the control surfaces.

Both wing panels are built at the same time directly over the plans. The ribs have large building tabs (almost as long as the ribs) that keep things straight and ensure proper built-in dihedral. The ribs are laser-cut, with the tabs attached to the ribs by very small "bridges" of balsa, so they have

to be handled carefully. I was impressed with the quality of the balsa and laser-cutting. When you pin the ribs to the plan, make sure that the rear edge of the tabs is on the trailing edge (TE) of the wing. After I pinned the ribs over the plan, I added the 1/4-inch-square balsa top spar, 1/16-inch leading edge (LE) sheeting, 1/4x1/2-inch TE and the 1/16-inch TE sheeting. Addition of the center sheeting and capstrips completes the upper surface of the wing. I then removed the wing from the building board, turned it over and pinned the spar flat to the board. Shims are used to support the TE to keep the wing straight during the remaining building steps. The center section is then reinforced with several laser-cut lite-ply parts that also support the wing dowels.

There were a few minor glitches in the next few steps in the instructions. Step 27 tells you to remove the dotted section of rib R1 if you are using a single aileron servo in the center of the wing, but there is no dotted section showing the aileron cutout on R1. Step 28 tells you to cut a hole in the bottom sheeting for the servo, but the bottom sheeting has not yet been applied. The photo in this step shows the upper sheeting—not the bottom. Remember, the wing has been flipped over, and you are now working on the bottom. This step is repeated correctly as step 3 in "Radio Installation." And finally, step 30, which calls for the addition of the bottom TE sheeting, is a repetition of step 21.

I made a modification at the center of the wing. I placed one R1 rib on each side of the servo opening instead of using a single rib in the center, which would have to be cut out to make room for the servo. This helped support the sheeting around the opening.

The wing was completed with the addition of center sheeting, capstrips, LE and tips. The ailerons, which are fitted later, are made out of solid aileron stock and are operated via bellcranks with a single servo in the center of the wing. Some builders might opt to use two microservos in the wing panels.

FLIGHT PERFORMANCE

The first test flights and photo shoot took place on a beautiful sunny day with a moderate wind. The control surfaces were set at the recommended "low rate" throws.

• TAKEOFF AND LANDING

My concerns about the small wheels and wheel pants on a grass runway turned out to be justified, as the Giles took a long time to generate enough speed to get off the ground. Once airborne, a few minor trim adjustments had it flying straight and level. It had the feel of a much larger airplane, and I was pleasantly surprised to see how smoothly it flew.

During the first flight, I discovered that the Giles had a tendency to snap, so I decided to maintain a moderate speed for landing. This turned out to be a wise decision, as the Giles remained steady all the way to touchdown and rollout.

• LOW-SPEED PERFORMANCE

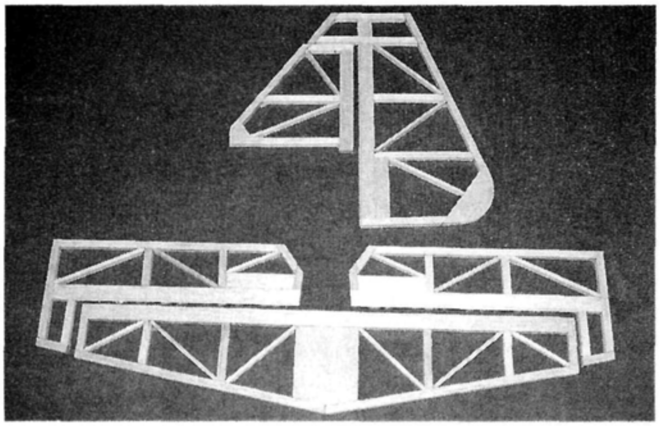
The Giles is not the kind of plane you fly around the sky in a lazy fashion. Initial flights with the Saito FA-30S 4-stroke were a bit hairy, as the engine turned out to be too small for the Giles and, at the low speed the plane was flying, it tended to snap when too much up-elevator was applied. Things improved significantly after I switched to an O.S. FP .25 2-stroke, but I still don't try to fly this one really slowly. I think the Giles would be a real performer with a .32 to .40.

• HIGH-SPEED PERFORMANCE

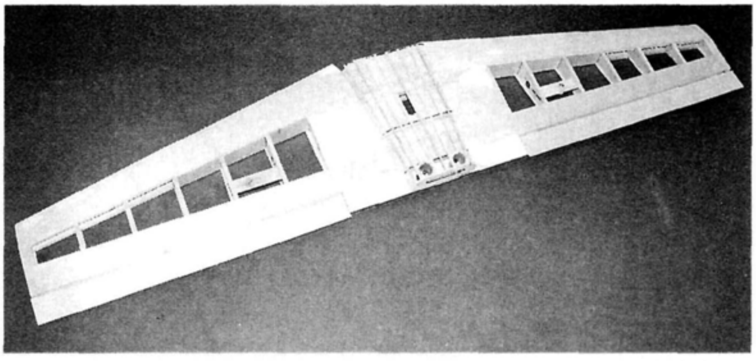
The Giles performed much better with a .25 2-stroke engine but still snapped when entering a tight loop. I reduced the elevator throw to half of what was recommended in the instructions, raised both ailerons about an 1/8 inch and moved the CG forward about 1/2 inch. Now the plane tracks very well and is much more smooth and stable. I believe the most effective change was that of the CG's position.

• AEROBATICS

The Giles is a proven aerobatic airplane that's capable of every imaginable maneuver, and this one does quite well considering its small size. Axial rolls were incredibly fast, as were inside and outside snap rolls. Sustained knife-edge and outside 360-degree turns were no problem. Inverted flight required a fair amount of down-elevator. The snapping tendency was significantly reduced by the changes mentioned above. Now, loops are big and round.



The stabilizer and fin are built up over the plan.

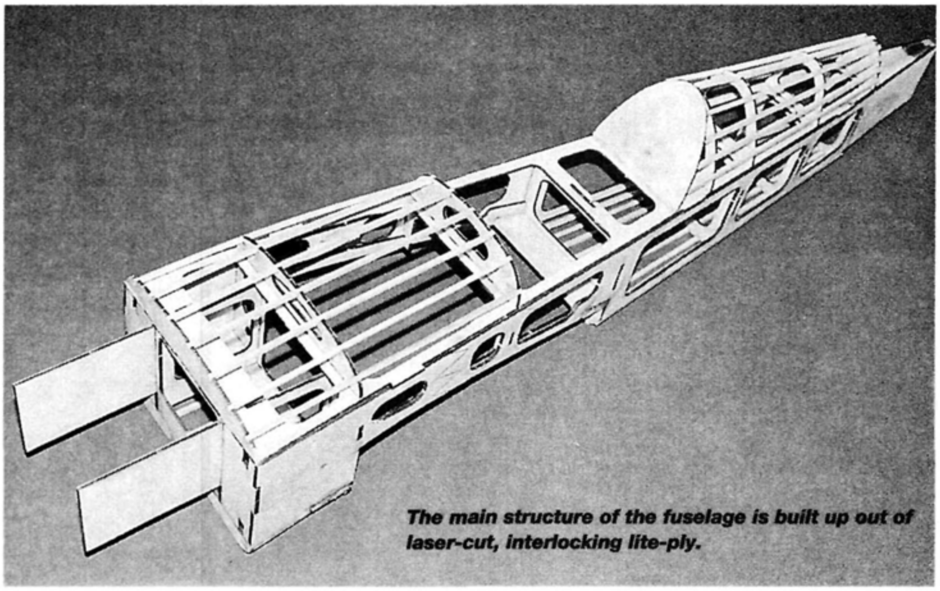


The laser-cut wing ribs have large building tabs that keep things straight and ensure proper built-in dihedral.

BUILDING THE FUSELAGE

The main structure of the fuselage is built up out of laser-cut, interlocking lite-ply. Once again, I found the laser-cutting to be excellent. Every part fit perfectly, and it was quite easy to keep everything nice and straight after I had aligned the first few parts of the forward portion of the fuselage. I used a bit of masking tape to hold things together before gluing. The top and bottom of the fuselage are made out of 1/8-inch-square stringers. Most of these are balsa, but a few in critical areas are spruce. The balsa stringers are very fragile, so I applied thin CA to strengthen them without adding much weight. (If you do this, be careful: 1 ounce in the tail can equal 4 ounces in the nose!) The next step is to sheet the top of the fuselage forward of the canopy with 1/16-inch-thick balsa. I sprayed the sheeting with detergent and water so I could bend it around the stringers without cracking it. The only modification I made to the fuselage was to sheet the bottom forward of the landing gear with 1/64-inch-thick plywood.

The top and bottom rear of the fuselage are finished off with balsa blocks, which have to be carved to shape. Two 1/4x1-inch pieces of balsa are used to simulate the stab and fin while you carve the tail



The main structure of the fuselage is built up out of laser-cut, interlocking lite-ply.

fairing blocks. The procedure described in the manual produces excellent results and makes this job a snap.

After fitting the wing and attaching it to the fuselage, I glued the stab and fin in place with 30-minute epoxy and added the tail-fairing blocks. I added pieces of $\frac{1}{4}$-inch balsa stripwood in the fin just above the fairing blocks to provide a surface to which the covering material could adhere. I then removed the wing from the fuselage and reinforced the center section with fiberglass cloth and thin CA.

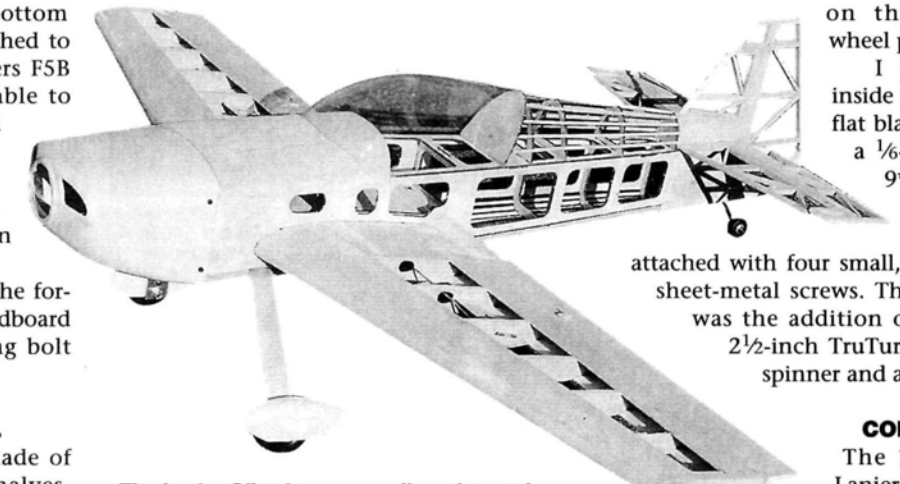
I came across the only notable "miss" when I began constructing the bottom portion of the fuselage that's attached to the underside of the wing. Formers F5B and F6 were too narrow. I was able to place F5B where F6 was supposed to go but had to make another, wider former to replace the original F5B. (I received a first-run kit, and these formers have been replaced in future kits.)

After attaching the stringers to the formers, I added short sections of cardboard tube and sheeting above the wing bolt holes for access to the wing bolts.

WHEEL PANTS AND COWL

The wheel pants and cowl are made of ABS plastic, and each comes in halves. After trimming and sanding the edges, I glued the halves from the inside with Super Jet CA and reinforced the joints with nylon tape and thin CA. A lite-ply cowl ring provides rigidity inside the rear edge of the cowl, and I also reinforced it with nylon tape and thin CA. I attached the cowl to the fuse with four, 4-40 Allen-head bolts that are threaded into cowl mounts on the sides of the fuselage. The wheel pants are attached to the formed aluminum landing gear with 4-40 Allen-head bolts and blind nuts. I initially installed 2-inch wheels on $\frac{1}{8}$-inch Du-Bro axles, as called for in the plans and, although the wheel pants and small wheels looked good, I began to wonder how well they would do on our grass runway. I ended up using $2\frac{1}{4}$-inch wheels instead. I attached the landing gear to the fuselage with three no. 6 sheet-metal screws, but these turned out to be too weak. I later replaced them with three 10-32 nylon bolts that I threaded into the plywood landing-gear plate.

The Giles was now all framed up and ready for covering, and it weighed only 42 ounces!



The Lanier Giles is a very well-engineered kit. All the parts fit perfectly, and it was relatively easy to build.

RADIO AND ENGINE INSTALLATION

Radio installation was routine. One standard servo is mounted in the center of the wing for the ailerons. Three additional standard servos are mounted side by side in the fuselage for throttle, rudder and elevator. These are mounted on $\frac{1}{2}$x$\frac{3}{8}$-inch-ply servo rails. I used a nylon pushrod for the rudder and two nylon pushrods for the elevator halves instead of the single pushrod with Y-connector called for in the instructions. I supported all the pushrods at the formers to prevent buckling.

For power, I first installed a Saito* FA-30S 4-stroke engine with stock muffler, and the whole thing fit nicely inside the cowl with only a small hole required for the exhaust. (Although the Saito FA-30S is a little gem of an engine, I realized after the first flight that the Giles was a little too much airplane for it. I installed an O.S. FP .25 2-stroke with a Slimline* Pitts-style muffler; this was a much better match.) I followed the sequence given for mounting the motor and cowl, but the prop shaft did not come out in the center of the cowl opening. I removed the firewall and used the following procedure to get things lined up: first, I re-attached the firewall as per the instructions, then attached the cowl and positioned the engine so the prop shaft and spinner were centered in the cowl. Then I drilled the holes for the engine mount and mounted the engine. This time it came out perfect!

FINISHING

I covered the Giles with bright yellow and white Goldberg Ultracote and used $\frac{3}{16}$-inch black Ultrastripe for the pinstriping. Ultrastripe is sticky on one side and can be positioned and repositioned easily before being permanently sealed with a sealing iron. It is polyester and does not melt or bubble when heat is applied. I used matching Goldberg Ultrapaint on the cowl and wheel pants.

I painted the inside of the canopy flat black and added a $\frac{1}{6}$-scale Hangar 9* civilian pilot figure. The canopy is attached with four small, button-head, sheet-metal screws. The final touch was the addition of a beautiful $2\frac{1}{2}$-inch TruTurn* aluminum spinner and a 10x6 prop.

CONCLUSION

The 17.5-percent Lanier RC Giles is a well-engineered kit that's relatively easy to build, looks great and is very aerobatic. I enjoyed building and flying this airplane and recommend it for anyone with average building and flying experience. This is certainly not a trainer, but anyone who feels comfortable flying a 4-channel, aileron-equipped model should have a ball with this one.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

PRO-POD

A 1/2A electric competition sailplane

SPECIFICATIONS

Model: PRO-POD

Type: competition sailplane

Wingspan: 63 in.

Wing area: 410 sq. in.

Length: 34 in.

Weight: 19.6 oz.

Wing loading: 6.9 oz./sq. ft.

Engine used: MFA Rocket 400

Gearbox: Graupner in-line 4:1

Prop: Graupner Cam Gear 11x8 folder

No. of channels: 3 (rudder, elevator and motor throttle)

Battery: Sanyo 7-cell 500 or 600mAh

Comments: designed by Bob Aberle for 1/2A Electric Sailplane events, the PRO-POD is a lightweight, rugged, highly maneuverable model. It's easy and inexpensive to build and uses inexpensive motor and radio components.

PHOTOS BY BOB ABERLE

by Bob Aberle

SEVERAL YEARS BACK, the National Electric Aircraft Council (NEAC) proposed a new event to be provisionally flown at the annual AMA E-Nats, or Electric National Championships, in Muncie, IN. The event was limited to Speed 400 motors and 7-cell battery packs. Because of the small size, the expression "1/2A" got tacked on to the title; hence, we have called it the "1/2A Electric Sailplane Event." By next year, it is anticipated that this event will achieve official AMA status as a regular E-Nats competition.

The rules for ½A Electric Sailplane are simple. Besides the motor and battery limitation, you are allowed a 90-second motor run. After the motor is cut off, the clock continues to run while the pilot pursues a total 8-minute flight time (sum of motor run and glide). The time must be exactly 8 minutes. For each second above or below 8 minutes, you lose points. Your timer is allowed to prompt you on the remaining flight time at your request. Also, a spot landing circle is set up where pilots can earn extra points for precision landings. So you must stay up an exact amount of time and also land on a designated spot. Points are lost if any part of the model—even a broken prop blade—falls off on landing.

TYPES OF MODELS

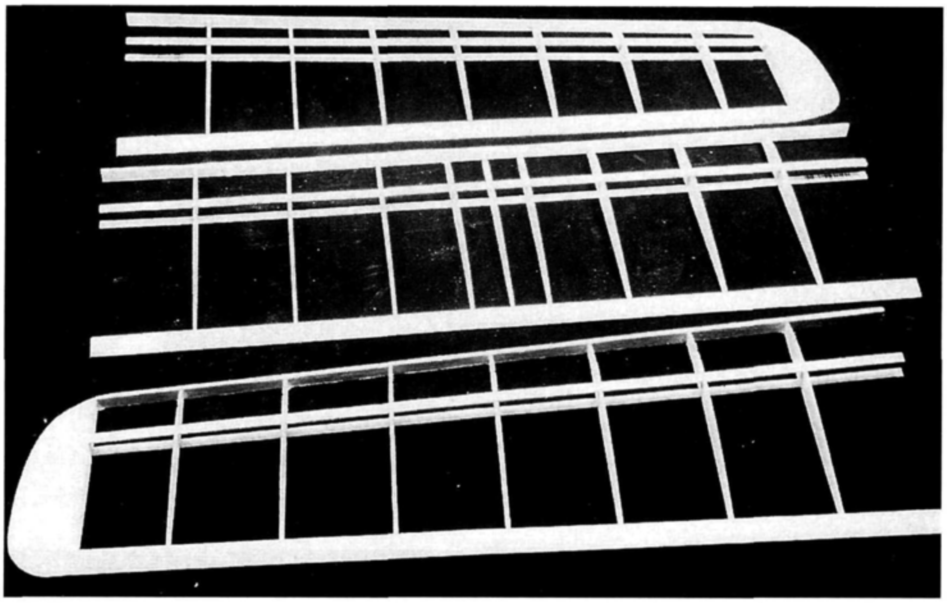
Because these rules were created several years ago, a typical electric sailplane has evolved. It has roughly a 60-inch wingspan with an area of 400 square inches. The total model weight with motor, battery and R/C is typically around 20 ounces. Experience has shown that a model with about a 23- to 24-ounce total weight will not be nearly as competitive as a 20-ounce (or lighter) model, so weight is a critical part of the design criteria.

To get the very most out of Speed 400 motors, modelers have almost exclusively switched to gear or belt drives to use larger diameter props. These models will typically swing 11-inch-diameter props at about 4,000rpm with a motor current of 12 amps (on 7 cells). Because you need only a 90-second motor run, 500 or 600mAh capacity batteries are sufficient. A 7-cell, 500mAh pack weighs around 5 ounces.

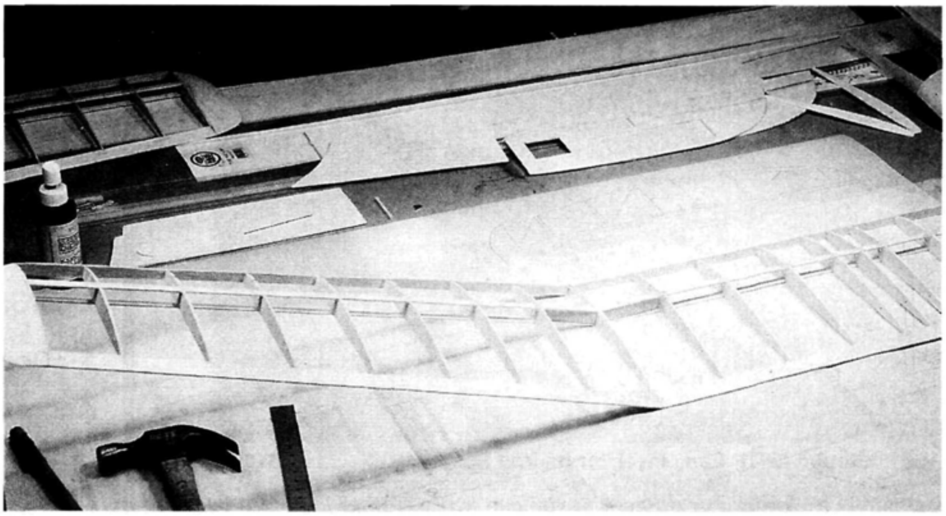
PRO-POD DESIGN

I always like to be different. The idea behind the PRO-POD was to have a minimum fuselage cross-section to reduce drag. I had wanted to try a pod-and-boom configuration for a long time and got my chance at last. With some careful planning and the use of small R/C equipment, I was able to design the pod as almost a profile (it has very little thickness); hence the name "PRO-POD," short for Profile-Pod.

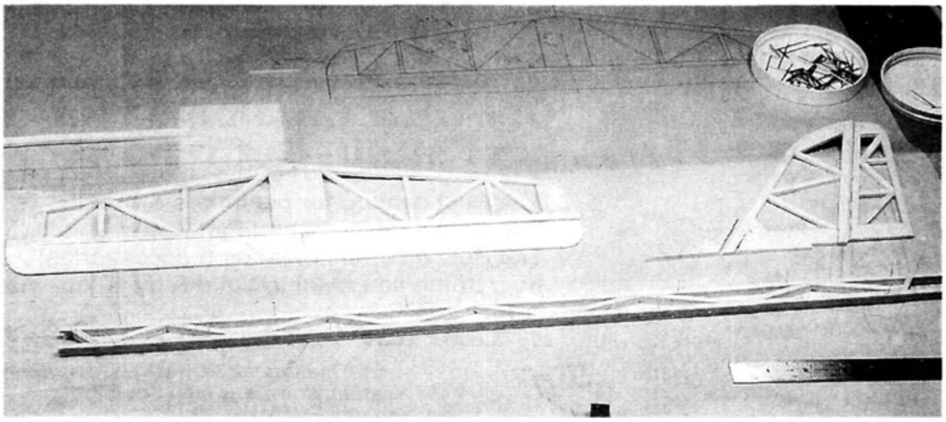
The wing took its shape from the popular Chet Lanzo old-timer, the Lanzo Bomber. It has a flat center panel and two tip panels with a large amount of polyhedral (about 18 percent). That, combined with a modern airfoil such as the SD-7037, worked out well. The result is a lightweight design totaling only 19.6 ounces and with a wing loading of just 6.9 ounces per square foot. After its 90-second motor run, the PRO-POD is almost out of sight. The glide is flat and slow, and the polyhedral in the tips makes it very maneuverable and helps to zero in on the spot landing circle. Believe me, PRO-POD is a very competitive machine for this new event. Best of all, it took me only three days to build and cover!



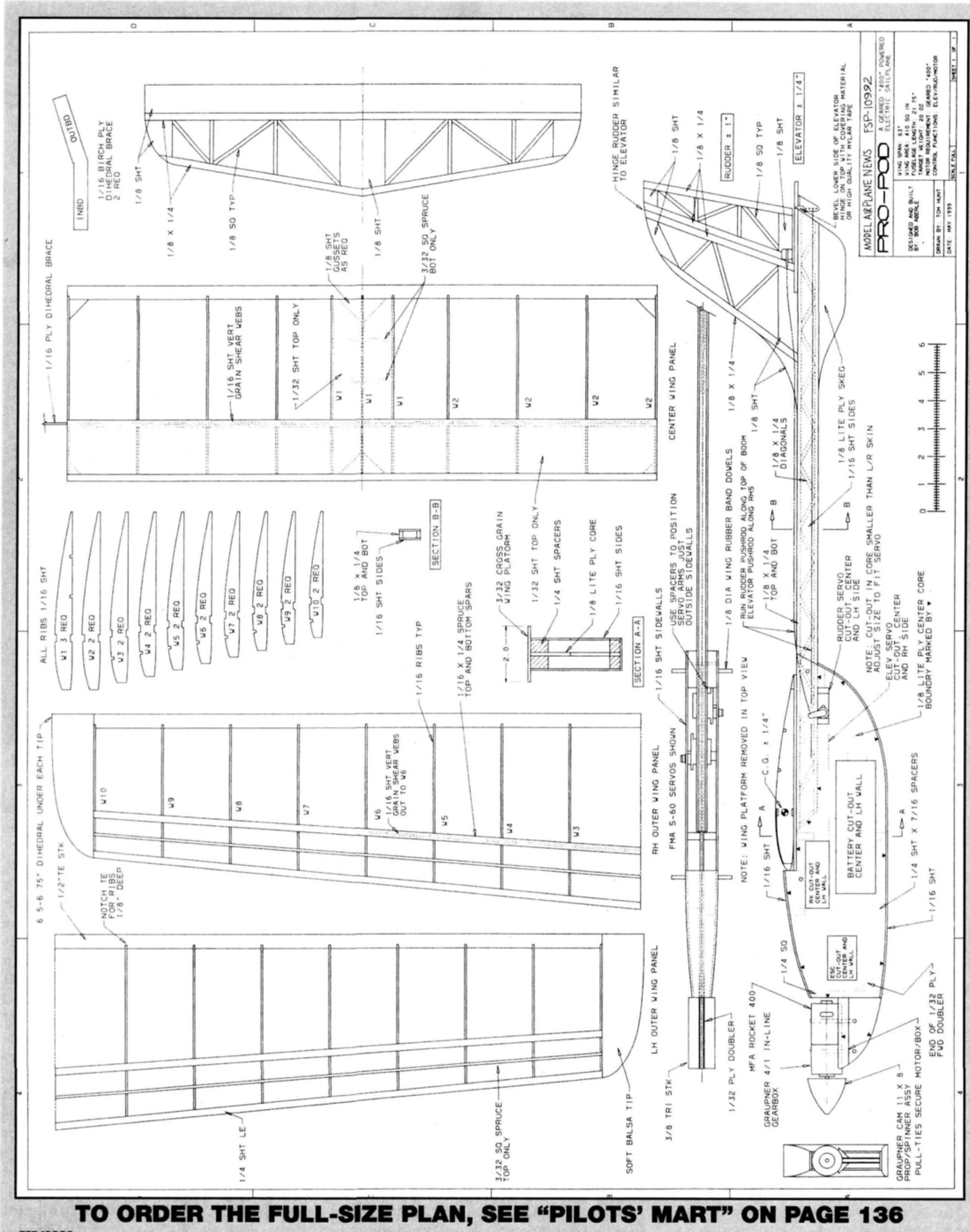
The framed components of the wing: a flat center panel and two tip panels. The covered wing weighed just 3.7 ounces.



Setting the polyhedral angle in the wingtip. Only two such joints are required in this design.



Completed stab and vertical fin structure. The fuselage boom is ready for the addition of the other 1/16 balsa side.

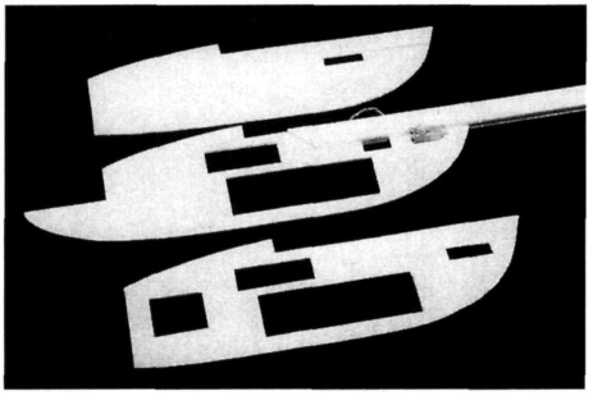


TO ORDER THE FULL-SIZE PLAN, SEE "PILOTS' MART" ON PAGE 136

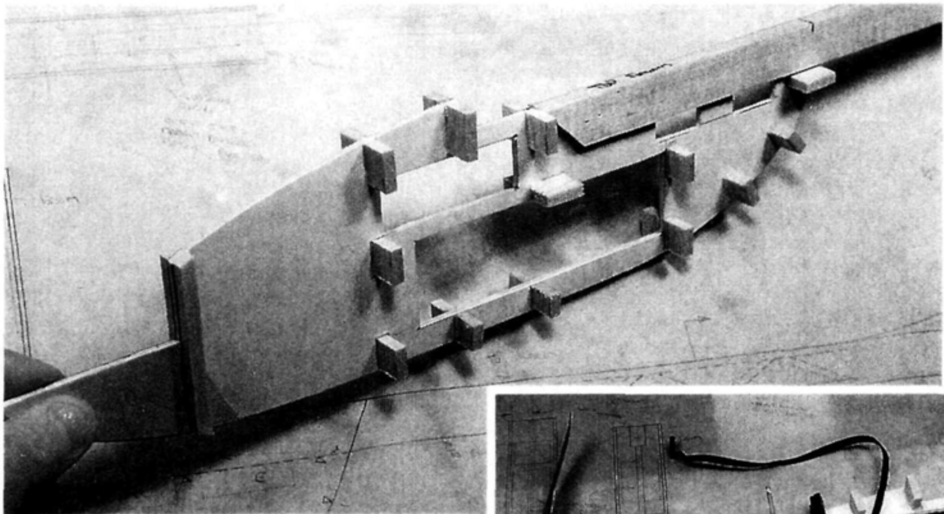
FSP10992
PRO-POD
Designed by Bob Aberle for ½A Electric Sailplane events, the PRO-POD is a lightweight, rugged, highly maneuverable model that features a nearly profile fuselage for reduced drag. It's easy to build and uses inexpensive motor and radio components. WS: 63 in.; L: 34 in.; weight: 19.6 oz.; motor: Speed 400; no. of channels: 3; LD 2. **$14.95**

CONSTRUCTION TIPS

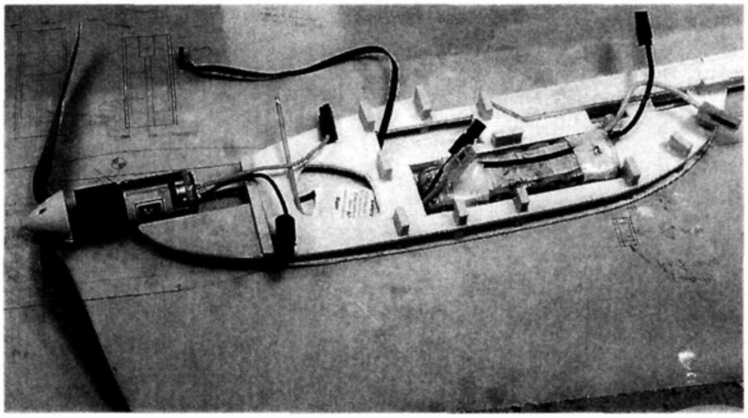
Build the wing first. All the ribs are made of medium to hard 1/16-inch balsa. Make plywood templates and place them on opposite sides of a stack of balsa sheets, then cut between the plywood templates. This yields about 8 to 10 identical ribs. The plans also show each individual rib shape for those who like to cut out a lot of separate parts. Keep in mind that the main spars are 1/16x1/4 spruce, not balsa.



The individual pieces that make up the pod structure: the balsa right side (top), the 1/8 lite-ply core with the boom already attached (center) and the balsa left side with the appropriate cutouts (bottom).



Above: the center pod core with the spacers that provide the pod's thickness. Right: just to give you an idea of where we are going (left to right): the motor assembly, the ESC and the 7-cell, 500mAh battery pack.

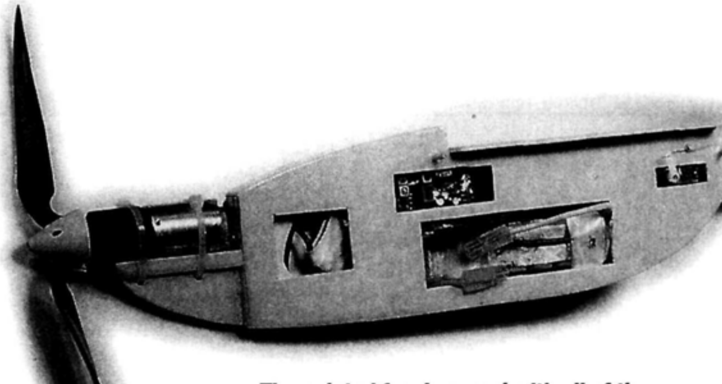


You'll also need hard 1/32 sheet balsa for the vertical grain webbing between the spars, halfway out to the tips. To give you an idea how light this structure can be built, my covered wing weighs exactly 3.7 ounces.

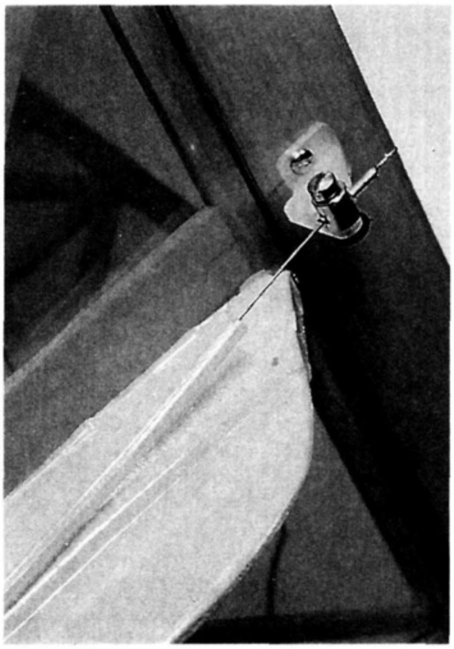
The fuselage is next. Start with the boom, which is made out of 1/16 balsa sides with strips of 1/8x1/4 at the top and bottom. More 1/8x1/4 strips are run diagonally along the inside of the boom.

The pod itself is the trickiest. Carefully study the photos before you cut the wood. The center core piece of the pod is 1/8-inch lite-ply. Note that you have to make cutouts in this core for the battery pack, receiver, speed control (ESC) and servos. Also note that the motor is mounted to the forward area of this core piece. At the very front, a 1/32-inch ply doubler is cemented to either side of the core to add additional strength.

The two pod sides are 1/16 balsa. The left side contains the necessary cutouts (similar to the core), while the right side has only one cutout for one of the two servos. Basic pod assembly involves attaching the boom to the pod, then making a series of spacers out of scrap balsa to suspend the sides from the pod core. In other words, you end up with balsa sides that are a small distance away from the plywood core. When this is done, close in the top and bottom of the pod with 1/16-inch balsa sheet with the grain running across. The wing-mount platform is made of 3/32 hard



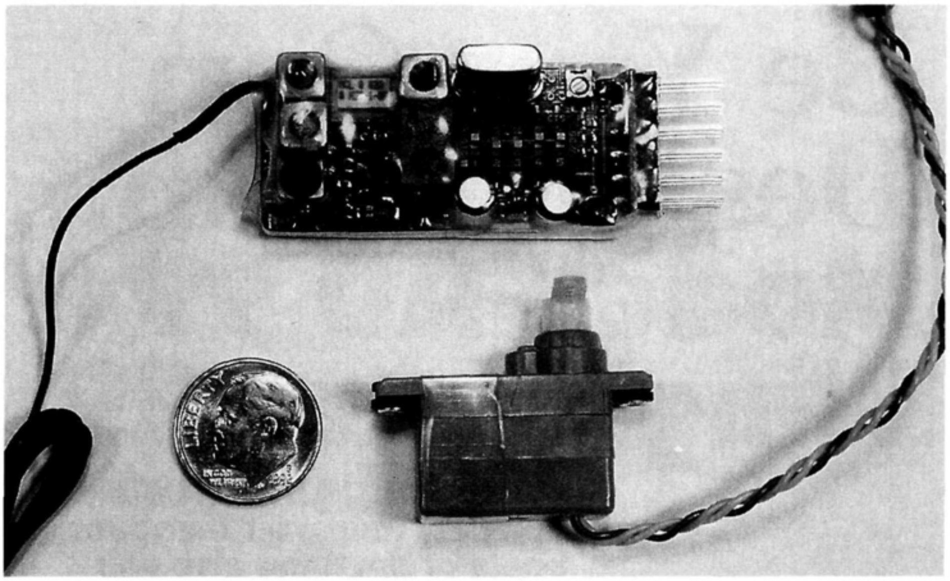
The painted fuselage pod with all of the radio and motor components in place. The last thing I did was to cover the ESC and receiver openings with some yellow covering material.



Du-Bro 1/2A control horns and E-Z connectors are used for both the rudder and elevator.

balsa, and 1/8-inch wood dowels on the leading and trailing edges are used for the rubber-band hold-downs.

The tail surfaces are basically made out of 1/8-inch medium balsa. They can be covered at this point. To keep the weight down, I used Carl Goldberg* Ultracote Transparent Lite covering material. The rudder and elevator hinges are made out of it, too. It is even a good idea to add the rudder and elevator control horns (Du-Bro* no. 107) at this point along with the E-Z connectors (Du-Bro no. 121). The stabilizer/elevator and the vertical fin/rudder can now be cemented into place at the rear of the boom with 5-minute epoxy.



The radio equipment. The 0.5-ounce FMA Tetra single-conversion receiver and new FMA S-60 sub-microservo together weigh less than one ounce!

RADIO INSTALLATION

To save both weight and space, I chose the FMA Direct* Tetra FM single conversion receiver, which weighs 0.5 ounce, along with two of FMA's new S-60 submicroservos at 0.2 ounce each. This system was flown using an Airtronics* Radiant transmitter.

Both of these tiny servos are partially "submerged" into the sides of the pod so that just the output arm protrudes. The rudder servo sticks out of the left pod side, while the elevator servo sticks out the right side. Small hardwood pieces are set in place to accept the servo-mounting screws (two on each servo). For a control rod, I used 0.030-inch-diameter wire running inside the Sullivan* inner Gold-N-Rod tube. The rudder control rod runs along the top of the boom while the elevator rod runs along the bottom. At the rear, both control wires are inserted into the E-Z connectors on the control horns. You will need to solder 1⁄32-inch-i.d. brass tube on the ends of these wires so that the E-Z connector screw will pin the wire in place. At the servo end, I simply used a Z-bend on each wire where it is attached to the servo output arm. The final adjustment point is at the control horn end.

Both servo cables are passed forward toward the receiver. Because the rudder servo is farther aft, I needed a servo extension cable to reach the receiver. Be sure to get the correct polarity when you plug the servo connectors into the receiver. On the Tetra, the signal lead is closest to the label side of the receiver. The middle wire is battery positive, and the pin that's farthest from the label side is battery negative. Receiver connector no. 1 is for elevator, no. 2 is for rudder and no. 3 is for the ESC.

The ESC chosen for this application was the Lofty Pursuits LPSC Mini, which is no longer available. A good substitute is the Castle Creations* Pixie-14. It can handle up to 14 amps and has a BEC, which is essential in this application.

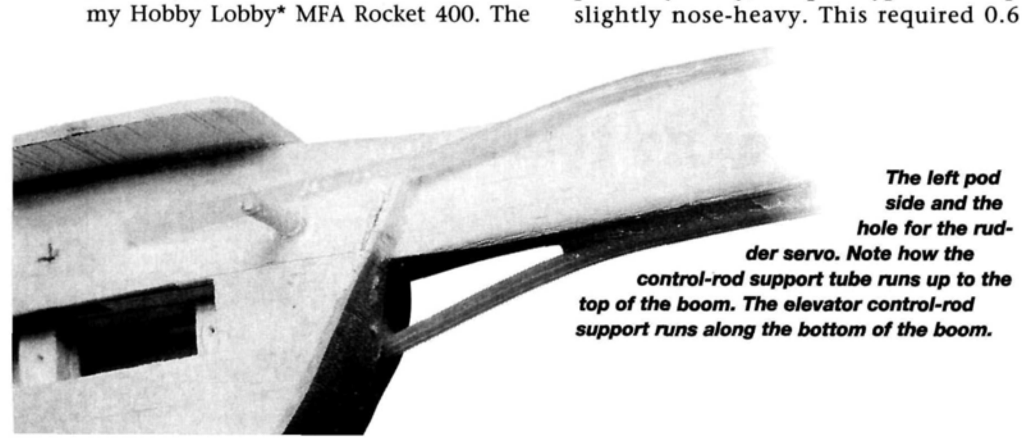
POWER INSTALLATION AND FINISHING

For this application, I added a Graupner* in-line gearbox with a 4:1 reduction to my Hobby Lobby* MFA Rocket 400. The prop of choice is a Graupner Cam Gear 11x8 folding prop that comes with the necessary prop adapter and a spinner. Total weight of the motor/gearbox and prop is a somewhat heavy 4 ounces. The motor is attached to the pod core up front with two nylon ties. Some scrap balsa on either side of the core helps to support the motor. A little clear silicone sealer was applied to prevent the motor casing from turning in flight. The positive and negative leads from the ESC are soldered to the motor terminals. The battery leads from the ESC are passed back out through the battery-pack opening on the side of the pod. Sermos* connectors are used for the battery connections. Velcro®-brand fastener was used to hold the battery, receiver and ESC in place. At this point, plug in a battery and try out the controls and motor.

The wing and tail are covered with Goldberg Ultracote Transparent Lite. The fuselage received one coat of Hobby Poxy* white undercoat primer followed by two coats of Hobby Poxy bright yellow. It was easier to paint the pod and boom than to try to fit pieces of covering all over the place. I placed a ½-inch-wide piece of plastic on the bottom of the pod with double-side tape to act as a skid.

FINAL CG AND CONTROL THROWS

Because the motor and gearbox are comparatively heavy, the prototype ended up slightly nose-heavy. This required 0.6 ounce of lead in the tail. The nose length on the final plans has been shortened slightly to cope with this problem. By eliminating this tail weight, the model weighs exactly 19 ounces, and it would have been even lighter if I had used the Pixie-14 ESC. Try to balance the model at the point shown on the plans. Rudder control throw ended up at 1 inch on either side of neutral. Elevator throw was about ¼ inch on either side of neutral.



The left pod side and the hole for the rudder servo. Note how the control-rod support tube runs up to the top of the boom. The elevator control-rod support runs along the bottom of the boom.

AT THE FIELD

Initial flight tests have shown the PRO-POD to be just about optimum for the ½A Electric Sailplane Event. Almost out-of-sight altitude is possible on the 90-second motor run. It is also easy to spin down out of a thermal to make the 8-minute flight limitation. Spot landings are a dream. I've been so impressed by the performance that I might consider a larger version of the PRO-POD to fly in the AMA Class A and B Electric Sailplane Events.

Only time will tell how good this PRO-POD design really is—especially flying it in the AMA E-Nats out in Muncie! The design is rugged in construction but still lightweight. This type of motor isn't known to have a long service life, but on the plus side, it is cheap! If you notice any deterioration in its performance, change to a new motor right away. It's a good idea to keep a new spare in your tool kit. Remember, all it takes to change a motor is a set of nylon ties. (Don't forget a 12V soldering iron to change the wiring.)

Good luck with your PRO-POD, and don't forget to share some of your photos with *Model Airplane News*!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

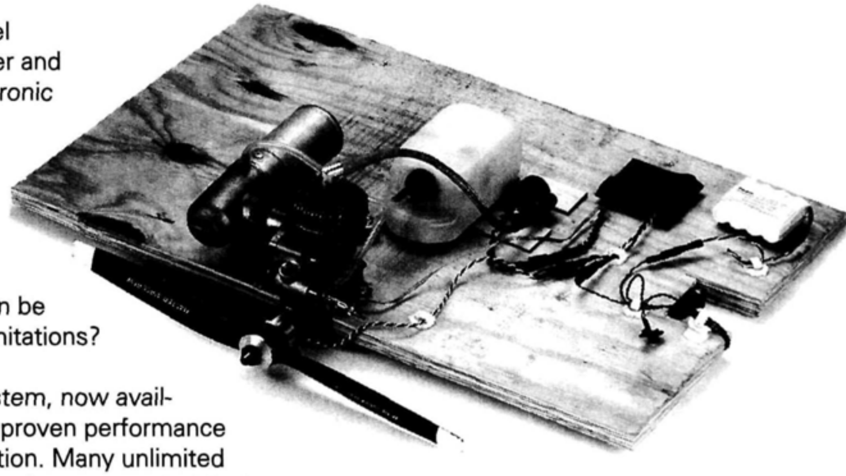
Run your SuperTigre G.90 on

Add the ProSpark electronic ignition

by Gerry Yarrish

IT'S FAIR TO SAY that big, gasoline-burning model airplane engines have a reputation for great power and high reliability. It is also accurate to say that electronic ignition technology has further increased the gas engine's user-friendly image by offering easier starting, low and reliable idle speeds and, in several instances, increased power. Although electronic ignitions that automatically adjust ignition timing are not a new development, their use with smaller glow engines is an area where several advantages can be gained. What are these advantages? Are there any limitations? Read on.

Over the years, the ProSpark electronic ignition system, now available from Nelson Hobby Specialties*, has achieved a proven performance record in both unlimited racing and aerobatic competition. Many unlimited racers, following the lead of NHRA top fuel drag racers, have converted their big gasoline engines to burn alcohol and found that electronic ignition works equally as well with this fuel. It was only a matter of time for the lessons learned in competition to trickle down to the sport modeler level.



Shown on my test stand, the ProSpark ignition system is very easy to install and set up. Deans connectors are supplied, but you'll have to supply the switch and battery pack.

WHAT'S THE DIFFERENCE?

In a nutshell, the big advantage of electronic ignition is that during the power cycle, it allows us to control when the engine ignites the fuel charge. This is measured in degrees of crankshaft rotation relative to the piston's vertical position in the cylinder sleeve. Specifically, when we say "advanced" timing, we are referring to a point at which the spark plug fires before the piston reaches its uppermost travel or before top dead center (BTDC). If a spark is produced after the piston reaches TDC, it is referred to as a "retarded" timing or after top dead center (ATDC)—the same terms that are used for full-size automobile engines.

The ignition module is roughly the same size as a 4-cell battery pack but slightly thinner. When mounted in an airplane, the module should be wrapped with foam.

In a glow engine that does not have ignition timing control, the glow plug ignites the fuel mixture at some point during the piston's upward travel, where compression is great enough to produce sufficient heat to fire the plug. This is also a BTDC timing, but it is not an exact, fixed position. Many things can affect the firing timing of the glow engine, including prop load (diameter and pitch), fuel mixture (rich or lean) and the type of glow plug used (long or short reach, hot or cold, idler bar or non-idler bar). In fact, when through trial and error we find the proper combination of prop, glow plug and fuel mixture that best works for our glow engine, you could say we are indirectly finding the optimum glow plug "timing" for our powerplant. One reason we often get our fingers smacked by the prop while starting a glow engine is because of its advanced timing position. By retarding the timing so that the plug fires at TDC, all engines become easier to start.

The timing adjustment potentiometer is easily adjusted through the opening in the module's cover. Turn it clockwise to advance and counterclockwise to retard the timing.

SYSTEM COMPONENTS

The ProSpark ignition system is made up of a control module and a high-voltage ignition coil that fires the spark plug. The system is also equipped with a Hall sensor pickup device and a rare earth

gasoline

and enjoy the benefits

The SuperTigre G.90 is a popular 2-stroke glow engine with good performance. Converting it to run on gasoline with the ProSpark electronic ignition system offers several advantages.

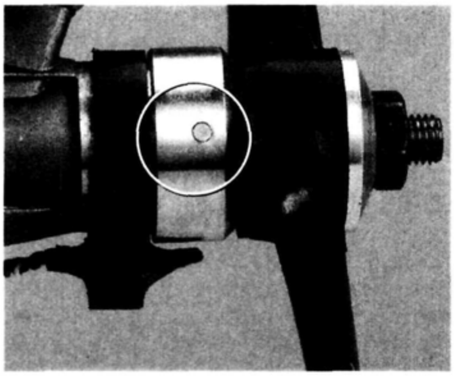
Switching from glow to spark ignition has several interesting aspects to consider. Here are some pros and cons.

ADVANTAGES

- **Improved reliability.**
- **Lower idle speed.**
- **Reduced fuel cost.**
- **Reduced fuel consumption.**
- **No field equipment required to start.**
- **Easier (safer) start (at TDC).**
- **Fuelproof finishes (more household paints from which to choose).**
- **Gasoline does not attract moisture while engine is in storage.**

DISADVANTAGES

- **Higher cost.**
- **More complex.**
- **Increased airframe weight (but requires less fuel on board).**
- **Increased exhaust temperature.**



The small dot on the side of the thrust washer assembly is the triggering magnet. You must drill a hole and press the magnet into place. When the magnet passes under the Hall sensor (shown below the thrust washer), the system energizes the spark plug.

magnet. This magnet triggers the Hall sensor and must be installed on the engine's prop thrust washer assembly. As the magnet (mounted X-face out) passes under the Hall sensor, the control module and coil supply energy to the spark plug. The system comes wired with Deans connectors, but you must supply your own heavy-duty switch harness for arming the ignition system, as well as an 850 to 1200mAh, 4-cell, 4.8V battery pack.

By installing a charge jack, you can simply charge your ignition battery at the same time you charge your model's radio. Make sure to clearly label each of the charging jacks.

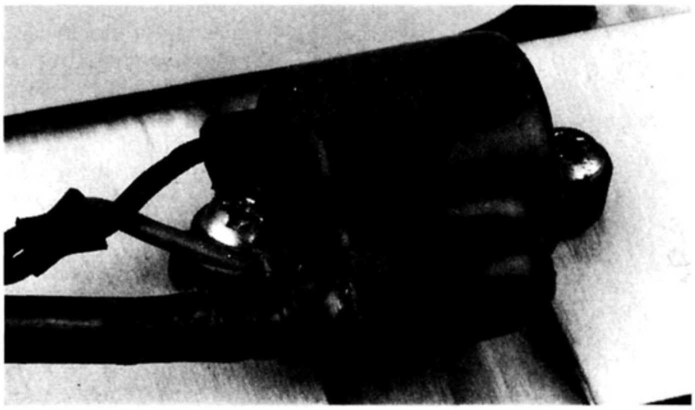
The coil has a shielded, high-voltage spark-plug wire and a shielded, metal spark-plug cap that locks onto the plug with a push-and-twist motion. A braided ground wire is also attached to the plug wire, and this must be attached to the engine for proper operation. The spark plug that comes with the system is a miniature NGK ¼-32 plug designed to replace a standard long-reach R/C glow plug. This spark plug is not a resistor type, but radio interference is not a problem because of the shielded plug wire.

IGNITION SYSTEM SPECIFICATIONS

Name: ProSpark electronic ignition system
Distributor: Nelson Hobby Specialties
Advance adjustment range: 0 degree (at start) to 38 degrees (above 5,000rpm)
Operating voltage: 4.8 volts
Current consumption: 120mA (spark plug not firing); 600mA max at top rpm
Max. engine rpm: 21,000
Duration w/1200mAh pack: 2 hours (8, 15-minute flights)
Spark-plug gap: 0.015 to 0.020 inch
Sensor/magnet gap: 0.015 to 0.035 inch
Firing voltage: 30,000 volts
Price: $199.95
Item number: PS104 (for single cylinder 2-stroke glow engines)

Includes: ignition module, high-voltage coil and shielded spark-plug wire and boot, ¼-32 NGK spark plug, Hall effect sensor, mounting ring and magnet. Arming switch and battery not included.

Comments: ProSpark is also available for several other glow engines including SuperTigre 2500 to 4500, O.S. 1.08, Thunder Tiger 1.08 to 1.20, as well as all gasoline engines such as Sachs, Zenoah, Quadra, Homelite, 3W, etc. The ignition system is also available for multi-cylinder engines.



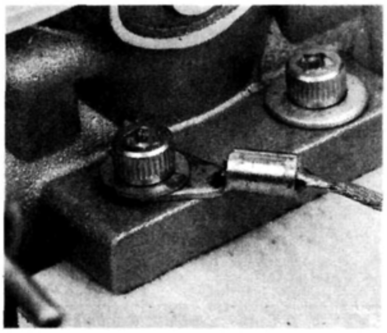
The system comes with a compact, high-voltage coil that needs to be attached to your model's firewall. Keep it and the rest of the ignition system as far away from your flight radio pack as possible.

HOW TO RUN YOUR SUPERTIGRE .90 ON GASOLINE

INSTALLATION

Start by drilling a hole in the side of the prop thrust washer assembly of your engine and "press-fit" the magnet into place so it is flush with the surface. Do not use a hammer to drive the magnet into place, as you could crack or damage the magnet. The hole should be 0.001 to 0.002 inch smaller than the diameter of the magnet, and a C-clamp can be used to press the magnet into the hole. If you drill a hole that's too big for a press-fit, use JB Weld or another similar metal epoxy adhesive to glue the magnet into place. Make sure that the X on the magnet faces outward. Replacement magnets are available from RadioShack for about $1.50 for two; ask for part number 64-1895.

The position of the magnet relative to the piston's TDC position is not critical, as the Hall sensor is completely adjustable and can be set at any position around the front engine-bearing housing. The Hall sensor is attached to the engine with a plastic mount ring and should be placed so the firing reference point (where the magnet is directly under the sensor) is at the piston's TDC position. The clearance between the Hall sensor and the magnet is not critical and should be between 0.005 and 0.035 inch.

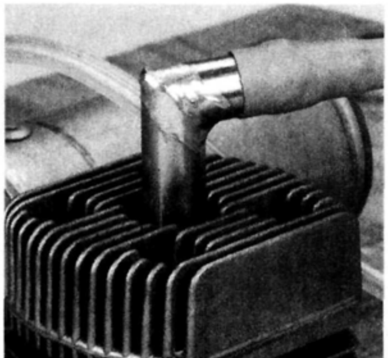


To operate properly, the ignition system needs to be grounded to your engine. To more easily attach it to the engine, I soldered a wire terminal to the end of the braided ground wire.

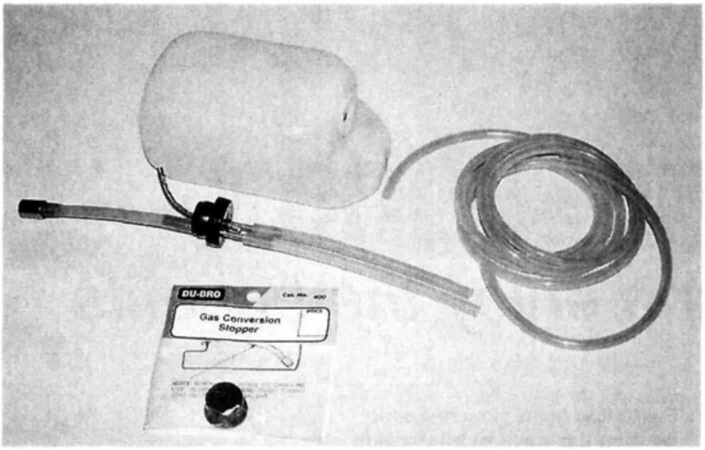
Do not install the sensor in a retarded (ATDC) position or the engine may experience hesitation and surging as the throttle is advanced. If you do experience these symptoms, advance the sensor about 1⁄16 inch at a time, counterclockwise or against the engine's rotation direction, until the engine runs smoothly. With the firing reference point properly set at the piston's TDC position, the timing adjustment potentiometer will adjust the top end advance from 22 degrees (fully counterclockwise) to 38 degrees (fully clockwise). The factory setting is approximately 32 degrees.

The glow plug is replaced with a miniature NGK spark plug that screws into the plug hole without modification.

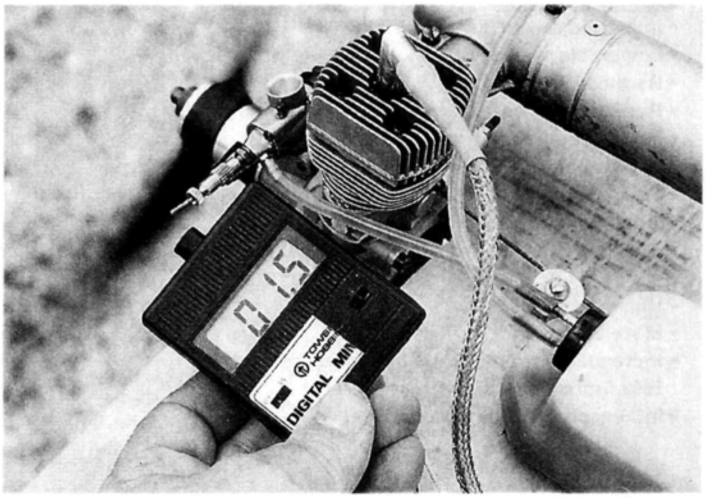
To minimize radio interference, always install the coil and control module as far away from the RX as possible. If space allows, it is perfectly fine to mount both directly onto the firewall within the engine cowl. In all cases, keep the ignition power battery pack at least 6 inches away from the RX, the RX battery pack, the radio switch and any servo leads.



The system also includes a shielded, metal plug cap that locks into place with a push-and-twist motion; a neat and secure installation.



To run your engine on gasoline, you'll have to convert your glow fuel tank so it is compatible with gas. I used the gas conversion stopper from Du-Bro and some Tygon gas fuel line.



1,500rpm; how's that for a low idle? The SuperTigre G.90 ran very reliably and never missed a beat; it also always started on the first flip of the prop.

OPERATION

The ProSpark system always starts the engine timing at the fixed firing reference point (TDC) and does not begin advancing the ignition until the engine reaches 2,500rpm. The system then continues to advance the timing until the engine reaches 5,000rpm, at which the advance setting is then held constant. As stated earlier, the top end advance can be adjusted with the module's adjustment pot. While making pot adjustments, you should use an 1⁄8-inch-wide, non-metallic screwdriver to prevent possible electrical shorting.

RUNNING THE ENGINE

I test-ran the SuperTigre G.90 on the bench and found engine operation to be very user-friendly; just like a gasoline engine! I ran a gasoline/oil mixture of approximately 15:1—almost twice the amount of oil normally run in big gas engines. This is because, unlike most gasoline engines, glow engines don't have needle bearings in the lower end of the con rod; the extra oil is required for proper lubrication. Also, when burning gasoline, the high-end needle valve becomes more sensitive, again similar to a gasoline engine; an 1⁄8 turn of the needle will result in a big mixture change. When adjusting timing, another important consideration is engine temperature; you should allow the engine to come up to temperature for about a minute before adjusting the advance.

To start the engine, choke it and turn it over until the carb is wet with gasoline (make sure that the ignition arming switch is off). Then open the throttle about 1⁄16 inch and turn on the ignition switch. The engine should start on the first flip and settle into a nice, low idle; in fact, during my tests, the ST G.90 never failed to start on the first blade.

Advance the throttle slowly to full open and then adjust the needle valve for maximum rpm. Use a tachometer, and when you reach max power, richen the carb a little for about a 200rpm drop. This is a good, safe place to operate. Wait a minute or two for the engine temperature to stabilize and then turn the adjustment pot fully counterclockwise, then fully clockwise. Note the rpm change for each adjustment, then readjust for max output. Here again, retard the setting slightly for about a 200rpm drop. Then you can go fly your plane.

Right away, you'll notice how very low the idle is. My ST G.90 could idle reliably as low as 1,500rpm; about 1,425rpm was the lowest I could run the engine. It would often come to a stop when the throttle was opened, but hey; this is very, very low!

The best performance I got from my setup was 10,500rpm turning a Master Airscrew* 14x6 prop. With a 14x8 prop, rpm dropped to 10,300. Slightly more rpm—11,600—was obtained with an APC* 13x6 prop. It is important to readjust your engine every time you change the prop or needle-valve settings. Running your engine with an overly advanced setting produces only more heat, not more power.

ST G.90 PERFORMANCE FIGURES

GLOW PERFORMANCE

Max. b.hp: 1.97 @ 12,768rpm
(SuperTigre Quiet Muffler/5-percent nitro)
Max. torque: 186 @ 5,923rpm
(SuperTigre Quiet Muffler/5-percent nitro)

Rpm	Propeller
12,100	APC 13x6
11,900	Master Airscrew 14x6
11,600	Master Airscrew 14x8

Idle
2,300rpm

(Rpm obtained with Wildcat* Heli blend fuel w/15-percent nitro and 18-percent oil)

GASOLINE PERFORMANCE
(87 octane/15:1 Havoline oil mix)

Rpm	Propeller
11,600	APC 13x6
10,500	MasterAirscrew 14x6
10,300	MasterAirscrew 14x8

Idle
1,500rpm

OTHER CONSIDERATIONS

It is possible to run your glow engine with standard glow fuel and the ProSpark ignition system. But to use gasoline, you need to consider a couple of things.

First, you have to convert your fuel tank's plumbing so it will be compatible with gasoline. Sullivan* and Du-Bro* both offer gasoline-compatible rubber stoppers for their fuel tanks. I use Tygon fuel line, available from Nick Ziroli Plans*. Use a gallon of fresh gasoline mixed with 8 ounces of Havoline 2-stroke oil, and use a filter when filling your fuel tank.

One of the biggest advantages of using gasoline is that the fuel consumption is almost half that of glow fuel for the same power. If you normally use a 16-ounce fuel tank, you can easily fly the same length of time with an 8-ounce tank. This equates to more usable internal space in the fuselage (or nacelle, for multi engines), though some of this space is taken up by the ignition module and extra battery. Also, you don't need a ground support system to start your engine; just flip the switch and turn the prop over! Add to this a lower idle speed, cheaper fuel costs and an increase in overall reliability, and you'll enjoy benefits in several areas, all of which will make your model—regardless of size—easier and more fun to operate. Put some spark in your engine's life and enjoy the difference!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

MODEL AIRPLANE NEWS

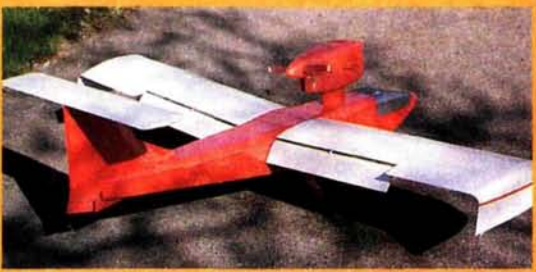
HOW TO

by Andy Lennon

The Robin lands deadstick.

STABILITY VS. MANEUVERABILITY

The Wild Goose; note three surfaces.



The Sea Gull III on trike gear displays its slotted flap.

The Crane STOL; note the slots on the leading edge.

AN AIRPLANE OPERATES in a three dimensional environment controlled around three axes (pitch, roll and yaw) and with 6 degrees of freedom. Stability varies from very stable to neutrally stable to unstable. An airplane that is very stable about all three axes is easy to fly, ideal for free-flight and as a trainer, but it is sluggish in maneuvers. It will recover quickly from disturbances and when the controls are neutralized and is relatively crash-free. A neutrally stable airplane has no inherent stability, is easily disturbed and must be flown at all times, calling for intense concentration and skill from its pilot. Any miscues, and gravity takes its toll! For sport models, stability is somewhere between these extremes and should suit the pilot's skills.

The Seahawk displays its large Youngman slotted flaps.

For good maneuverability, moderately high wing loadings of 20 to 25 ounces per square foot and power loadings of 200 to 300 ounces per cubic inch of 2-stroke engine displacement are recommended. An existing model may be modified, without too much effort, to that degree of stability/maneuverability that suits its pilot's increasing skills, or a new design may be developed to the same end.

The Swift shows its large flaps.

LONGITUDINAL, OR PITCH, AXIS

A model in steady, stable level flight is a remarkable balance of forces: thrust equals drag; lift equals weight; and the tail surfaces compensate for any nose-up or -down moments. The wing contributes virtually all the lift at its aerodynamic center.

The Canada Goose Canard.

The Dove.

However, each part of the model—fuselage, wing, tail, struts, landing-gear legs, wheel fairings, nacelle(s), etc.—has its own aerodynamic center.

In level flight, most of the airplane's parts are at an angle of attack of zero lift, contributing only profile drag. If a disturbance causes the model to nose up (or down), each component—not just the wing—starts to lift (up or down) with induced drag.

The focus of all these forces is a spot called the "neutral point," or NP. For stability, the model's center of gravity (CG) must lie ahead of the NP. This separation is called the "static margin" and is measured in percentage of the wing's mean aerodynamic chord (MAC).

The larger this percentage is, the more longitudinally stable the aircraft. If the static margin is thought of as a lever, the longer that lever, the greater the leverage, or moment, at the CG, and the model recovers more quickly. There are formulas for locating the NP, but these call for an assessment of the effectiveness of the various components and are beyond the scope of this article.

For a conventional model airplane, a conservative NP location is at 35 percent of its MAC, measured from that chord's leading edge. Flying wings have the NP coinciding with the wing's aerodynamic center of lift (AC). The CG must be ahead of this NP/AC location for stability.

CG LOCATIONS

Refer to Figure 1, which shows five CG locations within a wing's MAC:

• Position 1. Very stable longitudinally, but with weight acting downward at the CG and lift upward at the wing's AC, a strong nose-down force couple results, calling for a hefty download at the horizontal tail for equilibrium. This load is obtained by having the horizontal tail at a negative angle of attack to the wing's downwash and/or up-elevator trim. Down-elevator response is brisk, but up-elevator is sluggish.

• Position 2. Slightly less stable longitudinally (less static margin), but weight and lift oppose one another directly, requiring no up- or down-load at the horizontal tail. Elevator response is equally brisk, both up and down. This is the author's choice of CG locations.

• Position 3. Again less stable, but weight and lift now generate a nose-up couple, requiring that the horizontal tail provide some "uplift." Down-elevator effectiveness is reduced, but up-elevator response is good.

• Position 4. Neutral longitudinal stability. The model is highly maneuverable in pitch but is easily disturbed and must be flown constantly. Tail uplift is needed. With the fuel tank ahead of the CG, the rearward CG shifts as fuel is consumed; this may bring the CG aft of the NP to position 5.

• Position 5. Here, the NP to CG leverage is reversed and aggravates any disturbance. The model is unflyable with this CG location.

CENTRIFUGAL FORCE

A pattern model pulling out of a 100mph dive on a 100-foot radius will encounter a load of 7.7 times its own weight. The load on a 10-pound model would be 77 pounds, so a strong structure is needed. Also, models with heavier wing loadings (25 ounces per square foot and upward) risk the wing's maximum lift capacity being less than its load, resulting in high-speed stalls. The effect of centrifugal force on the four usable CG positions shown in Figure 1 is to exaggerate the forces of lift, weight and elevator action.

In position 1, the nose-down force couple is greatly increased, calling for powerful elevator action upward. In position 2, increased lift and weight neutralize each other without loading the elevators. In position 3, the force couple is reversed and centrifugal force assists the elevators. In position 4, centrifugal force (in this author's judgment) permits the weird, end-to-end, tumbling antics that some full-scale aerobatic monoplanes achieve.

OTHER FORCES AND MOMENTS

There are four other forces that affect longitudinal stability/maneuverability: thrust, drag, airfoil pitching moments and pendulum stability. A thrust line running through the CG produces no moment; above the CG, a nose-down moment results; below the CG, it causes a nose-up moment. Similarly, a drag center above the CG (high wing) causes a nose-up moment; a low drag center (low wing) produces a nose-down moment. If the drag center passes through the CG (mid or shoulder wing), no moment results.

Cambered mean-line airfoils (semisymmetrical, flat-bottomed, or under-cambered) have nose-down pitching moments. Symmetrical airfoils have no pitching moments.

A high wing and low CG provide pendulum stability both longitudinally and laterally. Low wing and high CG together have the instability of an upside-down pendulum.

Three possible configurations are:

1. Low wing, high thrust line, cambered airfoil, CG in position 1. All moments are nose-down. Down-elevator response is brisk, up-elevator is sluggish.

2. High wing, low thrust line, symmetrical airfoil, CG in position 3. Up-elevator response is brisk, but down is sluggish.

3. For best maneuverability, a thrust line through the CG (mid or shoulder wing), with the CG level with the wing's AC in position 2 and with a symmetrical airfoil, eliminates all moments and provides equal up- and down-elevator response.

It is no coincidence that full-scale aerobatic airplanes like the Laser 200 are close to this configuration.

GROUND EFFECT

This effect commences when the model is half its wingspan above ground or water. It increases the wing's lift and reduces drag similar to an increase in wing aspect ratio. It also reduces the wing's downwash angle to half its value at altitude.

In this author's experience, the model's wing loading controls its behavior in ground effect. A low wing loading permits the model to float for some distance.

For heavier wing loadings, coupled with slotted flaps extended, the reduction

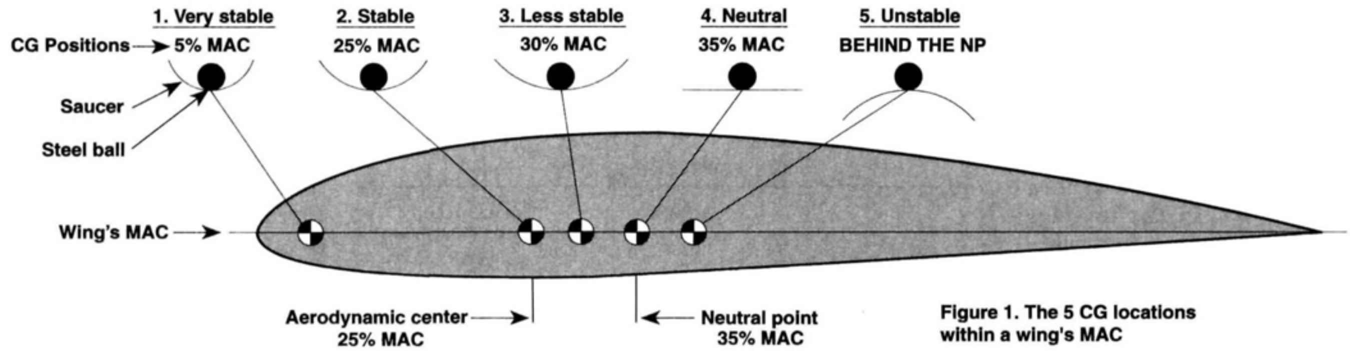


Figure 1. The 5 CG locations within a wing's MAC

in the downwash angle reduces the horizontal tail download, causing it to nose down for a hard landing. A touch of up-elevator provides easy correction.

CG ENVELOPE

The range of CG positions is called the CG "envelope." For sport models, the most rearward position should be 30 percent MAC, leaving a static margin of 5 percent for a neutral point at 35 percent MAC.

The most forward position depends on elevator power in pulling out of vertical dives and for full-stall landings of heavily wing-loaded models with flaps down. The author suggests a 16-percent MAC as the most forward acceptable CG location.

AIRFOIL STALL AND ZERO LIFT ANGLES

A wing loses lift at the stall and also at its airfoil's angle of zero lift. The stalling angle is affected by its aspect ratio, planform and Reynolds number. For conventional models that depend on one wing for lift, these angles are significant but not critical.

Canard, tandem-wing and three-surface models all depend on both wings for lift. For longitudinal stability, the foreplane must stall first, and the aft wing must reach its angle of zero lift first. The foreplane's airfoil must have heavier camber than that of the aft plane. Airfoils E214 (foreplane) and E197 (aft plane) have proven suitable.

For tail surfaces, symmetrical airfoils such as NACA 0009 and 0012 or E168 are much more effective than flat balsa sheet and will be lighter and stronger.

HORIZONTAL TAIL AREA AND MOMENT ARM

This author uses a horizontal tail area of 20 percent of the wing area and a tail moment arm of 2¾ times the wing's MAC, measured from the CG to the tail's ¼ MAC. For shorter moment arms, a proportional increase in tail area is indicated, and for longer arms, a reduction is in order. Horizontal tail aspect ratios should not exceed 5.

A horizontal tail that's vertically close to the wing's wake is in heavy downwash, in the fuselage boundary layer and the prop slipstream. It is 50-percent effective. A T-tail configuration raises it above the prop slipstream, out of the fuselage boundary layer and into lower downwash, where it is 90-percent effective. On high- and parasol-wing models, the best location is low on the fuselage, well below the wing's wake. This author has had no in-flight structural problems with T-tails.

ELEVATOR AREA

For models with forward CGs (position 1) and for those with slotted flaps, an elevator area of 40 percent of the horizontal tail's total area is recommended with 25 degrees of travel up and down. For other types, a 30- to 35-percent area is adequate for good longitudinal control.

The small, single-cylinder 2-stroke engine revolutionized model aviation. Models were larger, heavier and flew faster and longer than their rubber-powered predecessors. Serious stability problems emerged, particularly spiral instability. All of this took place before any form of R/C existed. Inherent stability in all three axes was a must—or the model crashed. A model airplane with little or no dihedral on its wing and with a large vertical surface is spirally unstable, but directionally stable. It is easily disturbed in roll; its path then becomes a combination of forward and sideways motions—which the vertical tail resists—and the spiral dive starts.

A model with heavy dihedral and a small vertical tail surface is the other extreme. It is directionally unstable and prone to Dutch roll. Somewhere between these extremes, a model is spirally and directionally stable.

Sometime after these small engines became available, Charles Hampton Grant, past editor of *Model Airplane News*, published his "Center of Lateral Area" (CLA) principles, which established a stable balance between the roll and yaw axes and prevented both spiral dive and Dutch roll. The leading model designers of that time adopted Grant's teachings and continued to do so during the rudder-only phase in the development of R/C. Today, with the precise, reliable and proportional control provided by radio, Grant's principles are not as important, but are no less valid.

This author designs for moderate spiral stability. It is comforting to know that a faraway model can be coaxed back without concern for spiral instability. Stability in roll and yaw are interdependent.

THE ROLL AXIS

The most popular means of obtaining stability in roll is dihedral, measured in the degrees each wingtip is angled upward from the horizontal. High dihedral angles reduce roll-control effectiveness; they should be kept to the minimum, just enough to ensure reasonable roll stability so that the model's maneuverability is not impaired. The suggested dihedral angles are quoted below and are based on experience.

DIHEDRAL

	With aileron	Without aileron or with forward sweep
High wing	2°	5°
Mid- or shoulder-wing	3°	6°
Low wing	4°	7°

Those rudder- and elevator-only models depend on the added dihedral for roll stability. The Dove is an example.

SWEEPBACK AND SWEEPFORWARD

Sweepback is mildly directionally stabilizing and provides a dihedral effect. Two to 3 degrees of sweepback are equivalent to 1 degree of normal unswept dihedral. Sweepback dihedral effect increases with the degree of sweepback and with increasing lift coefficient. This effect is lower at high speeds and low angles of attack and greater at low speeds.

A wing swept back 7 or 8 degrees on its ¼ chord (spanwise) line has the equivalent of 3 degrees of dihedral and needs no additional dihedral. For symmetrically airfoiled sweptback wings, the dihedral effect is the same, both upright and inverted, providing roll stability in inverted flight. Structurally, sweepback tries to twist the wingtips nose-down. Strength in torsion is needed.

Forward sweep is directionally and laterally destabilizing, requiring heavy dihedral and large vertical tail surfaces. It tries to twist the wingtips nose up, requiring torsionally strong structure. Its advantage is wing root stall, ensuring good roll control well into the stall.

ROLL CONTROL

"Roll Control Design," in the August '93 *Model Airplane News,* details the various forms of roll control that exist. The author's choice, for sport models, is the outboard, or barn-door, aileron. Equal up and down deflection of these ailerons produces adverse yaw, requiring coordinated rudder in turns.

Aileron differential, where the up-going aileron's angular travel is 2 to 3 times that of the down-going, eliminates adverse yaw so that no rudder coordination is needed.

A substantial portion of the wing's trailing edge is free for flaps.

Many pleasant hours have been spent flying a full-scale Piper Tomahawk. This plane's ailerons have no adverse yaw, thanks to aileron differential.

Slot lip ailerons have proven successful on two STOL models, Crane and Crow, and permit full-span flaps. The NASA "droop" provides good aileron control close to the stall.

High aspect ratio wings with the same degree of dihedral are more stable than shorter wings, but aspect ratios of up to 6 are more maneuverable. A high AR wingtip must move through a greater distance than a low aspect ratio wing for the same angle of roll.

YAW OR DIRECTIONAL AXIS

Grant's "Center of Lateral Area" principles had two major components:

• Wing dihedral of not more than 4 degrees.
• A center of lateral area (CLA) located at 20 to 22 percent of the tail moment arm from the CG to the vertical tail's aerodynamic center.

This produced excellent directional and roll stability—great for free-flight models and R/C trainers but seriously inhibiting maneuverability for R/C sport or aerobatic models.

Years ago, this author experimented with a large chuck glider to determine where the CLA should be for improved maneuverability yet with moderate spiral stability. Constructed of sheet balsa, this model had a constant-chord, unswept shoulder wing with 3 degrees dihedral. Four vertical tails, providing CLAs at 22, 25, 30 and 35 percent of the tail moment arm, were developed using Grant's cardboard profile method. These tails were readily interchangeable. Flight testing consisted of repeatedly and forcibly throwing each version, underhand and upward from right to left, with the wings close to vertical on release. The objective was to have each spiral upward and then assume its glide.

The 22-percent version was "wings level" halfway in its climb and then glided very stably to the ground, confirming Grant's concepts. The 25-percent version spiraled for less than half a circle and then glided, wings level, to the ground. The 30-percent version had mild spiral instability, and the 35-percent version was still spiraling on ground contact.

Because all of the author's designs have had the CLA at 25 percent, all confirm these test results.

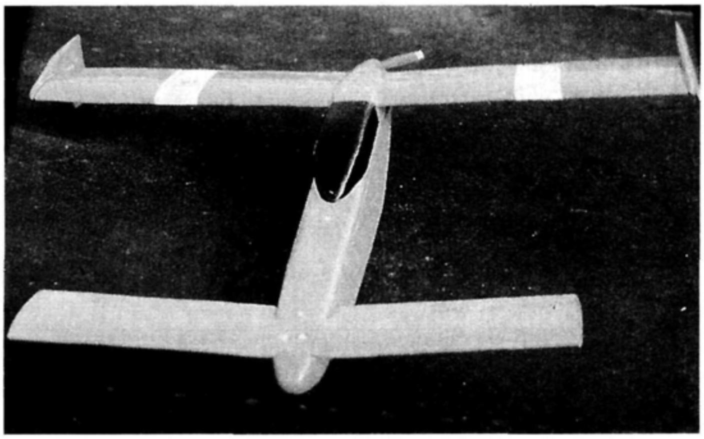
Grant's profile method for obtaining a proper vertical tail area for models with large, directionally destabilizing side areas ahead of the CG is essential. Such airplanes are flying boats, twin and single floatplanes, rear-engine canards, twin nacelles, etc.

Because of their roll and yaw instability, models with forward-swept wings are exempt from Grant's principles.

Suggested spiral stability margins as a percentage of the vertical tail moment arm:

Super spiral stability	22%
Good spiral stability	25%
Neutral spiral stability	28%
Mild spiral instability	30%
Spirally unstable	33% and upward

A full-scale Piper Tomahawk. Note the aileron differential; the upward aileron moves twice as fast as the downward.



The Swan Canard.

RUDDER AREA, DRAG AND WEIGHT DISTRIBUTION

Either side of neutral has proven adequate for sport models with a rudder area of 30 to 35 percent of the total vertical tail area and with 30 degrees of travel. For sailplanes and for knife-edge flight, 50 percent is suggested.

It is a shame to have much of the available power of a model's engine absorbed in overcoming that model's high drag. On a low-drag model, that power is usefully devoted to maneuvers. The Swift is an example of practical drag reduction. Its top speed is 138mph on .46 power. Drag reduction is well worth the effort and cost involved.

Keeping the heavy items (the power and control units) massed as close to the CG as possible will aid both stability and maneuverability because the model will have less inertia to overcome.

COUPLING AND CG LOCATION

Coupling occurs when the aerodynamic control for one axis causes movement in another axis.
• **Adverse yaw**—aileron action causing unfavorable yaw on the directional axis.
• **Yaw roll coupling**—rudder action causing the model to bank and turn. This is desirable for models with rudder- and elevator-only control. Extra dihedral ensures lateral stability and promotes the bank and turn.
• **Yaw pitch coupling.** A popular kit model has demonstrated a sharp nose-down pitch and yaw with rudder application and an upright and equally sharp pitch-up when inverted. British wartime test pilots reported that a captured German Me 109 had the same characteristics.

The sideslip is a maneuver involving crossed controls: ailerons applied to roll one way followed by rudder in the opposite direction. Before the use of flaps, this was standard full-scale practice to steepen the landing approach. A model with yaw pitch coupling should not sideslip close to the ground!

The author's T-tail designs have yaw roll coupling, but no yaw pitch coupling. The Tomahawk can be side-slipped with impunity.

Locating the CG on a model's drawings is easy. It is not so easy to have the model's CG in the right location when it is built. The author's article, "The Balancing Act" in the May 1993 issue of *Model Airplane News* will help and takes little time to complete.

These guidelines will provide a degree of maneuverability/stability to suit the designer/builder's skill level and the type of flying he or she finds enjoyable.

Happy landings.

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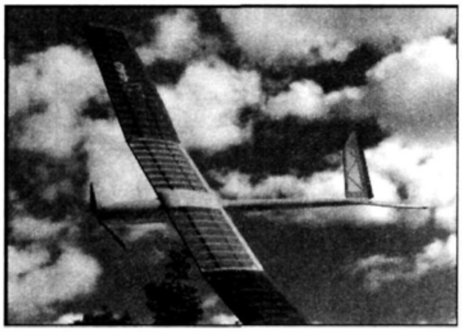

If you've seen one of our X440 kits, we really don't have to say much more. The X440 is as good as they come in construction and ease of building and flying. It has a 65" span and 442 square inches of wing area. It weighs 23 ounces for a wing loading of 7.5 ounces per square foot, ready to fly. The aspect ratio is 9.4:1 and it uses Speed 400 power and an optimized S3021 airfoil.

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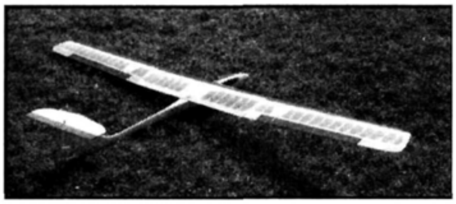

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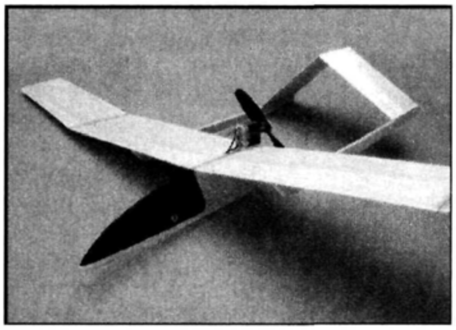


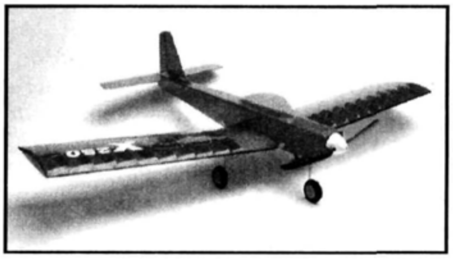
The X70 is a 26" span, 70 square inch hand toss or electric powered Free Flight aircraft that weighs only 1.3 ounces ready to fly!

The X70 is an SR MicroLaser™ Cut kit. The balsa is triple selected and it only takes about an hour of building to get the X70 flying.

The X70 kit is only $9.95 plus $3.50 postage and handling and that includes a copy of *Electric Flight Techniques* volume E-26 on Micro Electric Flight.

In addition, we have a power system for the X70 consisting of a Micro 4 motor, two 3.5x3.5 props, charging jack, charging plug, wire, and a two cell SR 50 Series battery pack for only $20 additional if you purchase it at the same time as an X70 kit.

The X250...



The X250 is a 36" span, 250 square inch Speed 400 sport aircraft. It weighs less than 20 ounces ready to fly. Full throttle flights are 7 minutes and partial throttle flights are well over 10 minutes.

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EFFECTIVE PROGRAMMING *by Don Edberg*

Offsetting a control

I get a lot of mail asking how to do things with radios. Here's one question I've received and answered that may be of interest to many modelers:

"I have an R/C combat plane that I hand-launch and have trimmed for level flight. Before I toss it, I put in <insert a number here> clicks of up-elevator to get it up, and afterward reverse the clicks. Can I program in a 'takeoff mode' with one switch?"

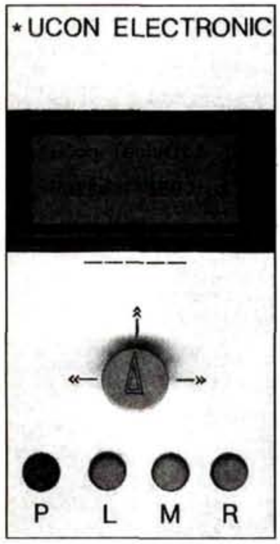
Sure you can. If you have a simple or older computer radio, the ways to do it will be limited. If you have a newer radio, there are several ways to do it; some options are shown in Table 1.

Table 1. Possible ways to program elevator offset at launch.

Method	Motion adj.	Notes
1. Airbrake function	Offset percent	Uses airbrake program.
2. Gear —> ELEV mixing	Use mix percent	Uses gear channel.
3. Any knob channel —> ELEV mixing	Knob position or mix percent	Can adjust (disturb!) in flight by turning knob.
4. Offset —> ELEV or multi-point mixing	Offset percent	Assign to desired switch. Independent of master control.
5. Flight condition	Neutral offset	Only available on expensive radios.

First, measure the travel needed. Before you set up the radio, you must first determine exactly how much elevator motion the clicks of trim produce. A simple way to do this is to measure the angle change that the trim clicks produce. Before and after applying the clicks of trim, you can measure the elevator's motion directly, or measure the rotation of the servo's arm. This can be done using a control throw measurement device or a ruler with fine gradations, or simply by marking the fuselage somewhere near the servo arm or the pushrod in a convenient place. For the rest of this column, we'll assume that the servo arm or the control surface moves a distance "A" when the trim clicks are put in.

My preferred method of measuring the command to the servo requires a special instrument called a "pulse-width meter," an electronic device that translates servo motion into a number. You have to temporarily unplug the servo from the receiver and plug in the pulse-width meter. It will measure the exact width of the control pulse coming from the receiver and display it digitally as a number of milliseconds ("ms" for short). Servo pulse-width meters are available from Radio South*, Aero Scientific* and Moecking*. They're not cheap tools (they cost $50 and upward), but they're handy to have around when you need them.



A servo pulse-width meter from Moecking.

Most radios have the neutral position around 1.50ms, and full motion is between 1 and 2ms. The actual number, however, is not important. What you need to know is the change in pulse width that the clicks of trim produce so you can reproduce it electronically with a switch on the transmitter.

So you note the pulse width that the receiver is sending with the trim neutralized; let's say it's 1.53ms. Apply the clicks of trim; the meter now reads 1.57ms. The difference, which happens to be 0.04ms, is the amount that you want to cause the servo to move.

OK, you've established how much you want the servo to move; either the distance "A" measured directly, or the number of ms on the meter. Let's move on to the next action: setting up the programmable radio to do the offset.

THE AIRBRAKE FUNCTION

I mentioned earlier that you need a programmable mixer to do this. That's not strictly true—some radios have an airbrake, or landing system, function that can be switched on and off. These functions allow you to command a certain amount of throw in flaps and elevator if the airbrake switch is on. Therefore, you could use the airbrake function to command the amount of elevator needed for launch simply by setting the offset to provide the measured amount of control or servo travel. If your system supports it, another way is to use its glider programming. Glider radios often have a start, or launch, function that offsets the elevator. With this option, you're of course forced to use the airbrake on/off switch when the offset is to be used.

If your radio doesn't have an airbrake function (or you're actually using the airbrake function as it's intended!), this option won't be available to you. In that

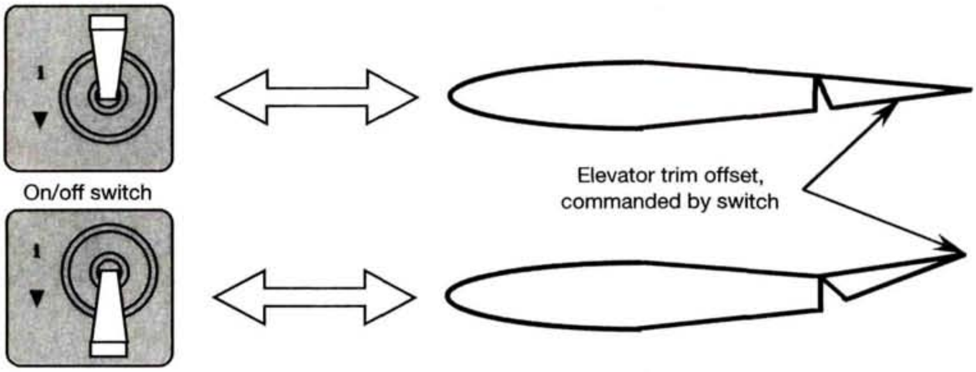


Figure 1. We want to get some elevator trim for hand-launching a combat model by turning a switch on the transmitter on and off.

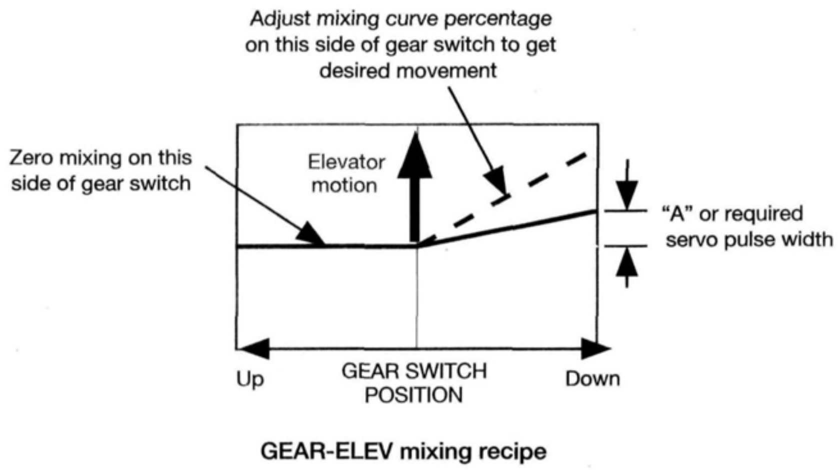


Figure 2. If we use the gear switch as master, the slope of the mixing curve determines the amount of elevator travel commanded.

case, you'll need a programmable mixer after all.

No matter what kind of radio you have, you want the elevator to move when a switch is pulled, so the slave channel will be elevator. The difference will be in how you program the master channel.

USING A PROGRAM MIXER WITH THE GEAR SWITCH

On a simple computer radio, you need to use a channel that's driven by a switch to be the master. This usually ends up being the retract gear channel. Even if you're using the gear switch for retracts, you can define master = gear, slave = elevator. When this is set up, pulling the gear switch will provide the required up trim (Figure 1).

Now, go to the program mixer's setup menu and define the master and slave channels. Then you'll set the amount of mixing. At this point, you'll need your measurement of the servo motion (you'll get things just right by trial and error). Because you don't want mixing on the "non-launch" side of the gear switch, you need a curve as shown in Figure 2. The mixing value is only input on one side of the switch (on the right side of the big vertical arrow; it's horizontal on the left side, meaning 0 percent there). The mixing percentage, which dictates the steepness of the line on the right, should be adjusted to get the desired elevator travel or pulse width. You may need to change the sign of the mixing percentage to get the correct direction of elevator travel, and be careful: usually only a small mixing percentage is needed. If it's too large, you'll get a lot of elevator travel with the gear switch, and this could lead to a crash!

If you use the gear channel to offset the elevator trim, be sure to specify that the mixer is on at all times. Otherwise, the "off" position of the radio's mixer on/off switch will turn off the offset, even if the gear switch is commanding offset to be there!

USING A PROGRAM MIXER WITH A KNOB

This is another way to program the elevator offset, only this time, you use a knob channel to control things. You can change the amount of mixing "on the fly" by moving the controlling channel's knob one way or the other, but of course, you can accidentally move the knob to an undesirable position.

The setup is very similar to that of the gear switch, only now the master channel is the knob channel. The slave is still the elevator, but this is where the fun starts. You can set the mixing percentage, but the knob controls the total travel, as shown in Figure 3. This means it's possible to have several different settings to produce the desired elevator motion. As you can see in Figure 3, with Line 1 and the knob at Position B, you get the desired elevator motion. You can also get it with Line 2 and the knob fully clockwise. And, you can get it at other places, depending on the slope of the mixing curve.

If you use this method, I recommend that you set up the offset using the smallest possible mixing rate, which is Line 2 in Figure 3. When you set things up that way, it's easy to verify that the controlling knob is all the way to one side. As in the previous example, be sure that this mixer is on at all times. If the mixer master switch is turned off, the offset won't be available even when you command it.

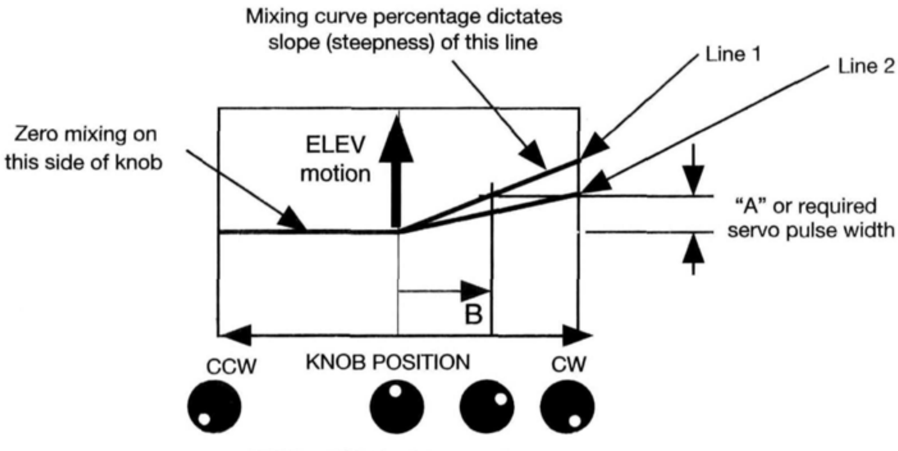


Figure 3. Another way to command an offset is to use a control commanded by a rotary knob as the master. You can adjust both the mixing curve slope and the knob position to get the desired travel. Full knob travel is recommended so that you know you've reached the proper position without looking at the knob.

OFFSET OR MULTI-POINT PROGRAM MIXERS

If you happen to have a Futaba* 8U or 9Z system, you can take advantage of a special mixer program called "offset" mixing. This is the most simple way to do the elevator offset. All you have to do is go to an available mixing circuit, set master = OFS, slave = ELE, and simply program in the offset amount numerically. You can also specify which switch to be used to turn the offset on and off. This usage is what the offset function is designed for.

Please note that the offset I refer to in this section should not be confused with the "offset" term that describes where the

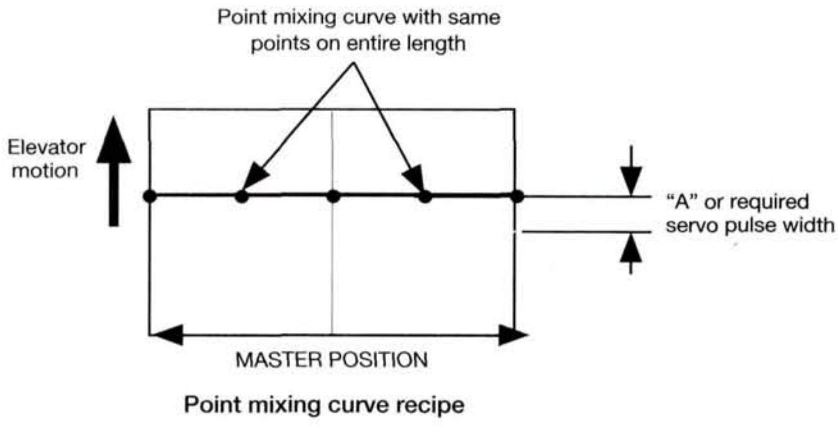


Figure 4. If your radio has point-mixing capability, you can define a switchable control offset by entering a horizontal curve as shown, vertically offset by the amount of control travel that you need.

mixing curve originates. Many computer radios allow you to offset the mixing curve, but only Futaba radios allow you to specify the slave's offset regardless of the master control.

The Airtronics* Stylus with the optional AERO card plugged in has a similar feature called "Automatic Offsets." On JR 8103 and PCM-10 radios, you can simulate this offset mixing by defining a horizontal "Multi-Point Mixing" curve, whose location happens to provide the offset you desire. This concept is shown in Figure 4. In this case, notice that all of the mixing points are at the same distance "A" above the center, which means that when you switch the mixer on, you'll get the offset you desire regardless of the master control's position.

OFFSET IN A FLIGHT CONDITION

Here's yet another way to produce the desired control offset, but it requires a high-end radio: the Stylus, 9Z, or PCM-10 series of radios. You define a new "flight condition," which has the neutral of the elevator offset the desired amount. A flight condition is a way of connecting a second model memory to the normal one. In this case, you'd define the elevator's neutral point to be in the desired different position compared with the default position, and you'd set up things so that the desired switch would toggle the model between the default and the "hand-launch" settings.

One nice thing about using the flight condition is that you're not limited to neutral positions. You can define a whole set of control travels, mixing, dual rates, exponential and mixing circuits that are different from those to be used in regular flight. In essence, the flight condition ties two different model memories together, easily selected by a switch! If you'd like to vary a whole bunch of control items between hand launch and normal flight, this is the way to go.

CELL PHONES AND R/C TRANSMITTERS

A recent posting on the Internet newsgroup rec.models.rc.air mentioned that the United Kingdom's Large Model Association has put out a warning about using cell phones near computer radios. Apparently, there have been a number of occasions on which these radios have either lost the model settings in memory or have scrambled them. In one case, a large model's throttle fail-safe was reversed so it went to full throttle on fail-safe.

Tests have confirmed that using a cell phone close to a computer radio can cause a loss of settings. Cell phones should not be used closer than 1 meter (39 inches) to a PCM transmitter or receiver. If you think that a phone has been used near your radio, you should check all settings before using the radio.

The message also noted that you are not allowed to use these phones closer than 1 meter to any hospital equipment containing a microprocessor. At less than a meter, there is a 1 in 20 chance of a malfunction.

If you have a problem you'd like to have covered in this column, please let me know. Send your letter along with an SASE to me c/o *Model Airplane News*, 100 East Ridge, Ridgefield, CT 06877, or email me at man@airage.com. I get lots of mail, so please be patient!

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

Setup and piloting tips for the beginner

SO YOU NOW have a shiny new helicopter with the engine, radio system and gyro installed. You're ready to learn to hover, and you head to your backyard or local flying field. But wait! The most important—but least understood—step for any beginning helicopter pilots is to have the model set up by an experienced heli pilot. It's much easier to learn how to fly with a heli that has been properly set up and trimmed.

Phyllis Bell demonstrates where a novice pilot should NOT stand. In this position, control inputs from the transmitter will not match the helicopter's reaction. Here, a left cyclic command will push the heli away from the pilot. Notice the Wiffle-ball landing gear on the Shuttle RG; this setup prevents the heli from tipping over.

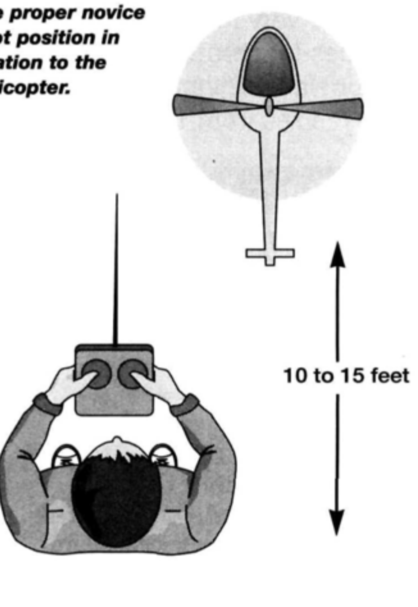
SOME THOUGHTS ON SETUP

What do I mean by setup? Before you fly an airplane, you "set up" the control throws, their direction, maybe dual rates and exponential, and you check the center of gravity, right? Well, you need to do the same with a helicopter, with the major difference being the throttle and curves. Many beginners have their helis' pitch curves (the pitch of the blades relative to the throttle input) set up with a lot of negative, so if they panic and chop the throttle, the helis pull themselves into the ground, resulting in a "boom strike" (this is what happens when the rotor blades hit the tail boom). A beginner's setup should use 0 or maybe +1 degree of positive pitch at low stick. This will bring the heli down less aggressively and lessen the chance of a boom strike.

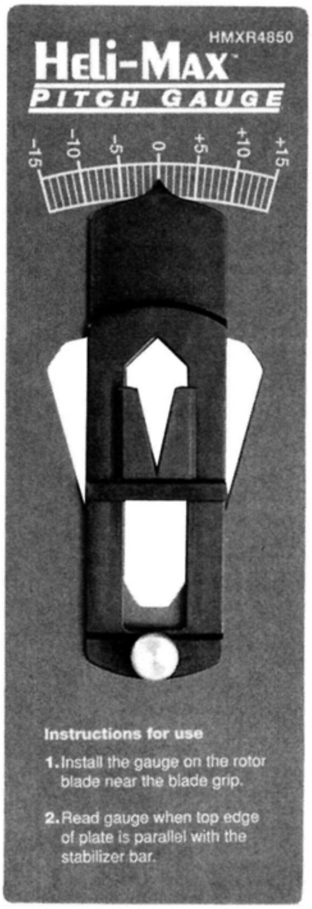
HOW IT'S DONE

Start by reading and understanding the setup instructions in the manual (this includes your radio manual, too). Most heli manuals recommend pitch curves that are too aggressive (too steeply pitched) for rank beginners. To accurately set the pitch, you will need a pitch gauge. Some kits supply a paper gauge, and although that's better than nothing, a proper pitch gauge is the way to go.

The proper novice pilot position in relation to the helicopter.



These rules apply to most helicopters, and the setups are pretty much the same; all control mechanisms and arms should be centered to make the controls more proportional to the stick movement. For example, you would follow these steps to set up a standard Hirobo* Shuttle: first center the collective lever in its travel, then set the pushrod at 90 degrees to the collective servo (make sure the collective stick on the transmitter is at its midpoint). Move the servo arm on the spline as necessary to achieve the 90-degree setting. Then center and level the swashplate, the washout unit and the flybar control arms. Now center the aileron, elevator and rudder servos, and set the pushrods at 90 degrees to the arms. You can use subtrim to achieve this (if your radio has this feature), but keep it to a minimum. All bellcranks and arms in the system should now be level or centered in their travel (see Figure 1). If you use a computer radio, make sure that all trims, subtrims, travel adjustments, curves (collective, throttle, etc.) and mixers are at their default settings before you start. This will minimize confusion during setup.



A pitch gauge like this one from Heli-Max* is a must for the heli pilot's toolbox.

Now that all the controls have been set, you can set up the pitch range. There are a few flying-style setups to consider: beginner, intermediate, FAI and 3D, or freestyle. The main difference between these setups is the pitch of the blade at center stick. The first three styles usually use 4 or 5 degrees of positive pitch at half stick, while 3D uses zero at half stick. Mark one of the blade grips and also one of the blades. This is now the "master" from which all pitch settings will be made. The other blade will be the "slave" on which initial tracking adjustments will be made.

Place the master blade in the master grip, level the flybar, and use the pitch gauge to check the pitch at low stick (0 percent), half stick (50 percent) and high stick (100 percent). For a beginner's setup, I recommend that you set low stick at zero, half stick at 5

Figure 1

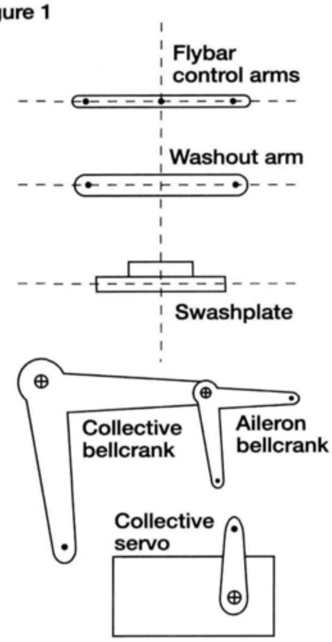


Figure 1. At hover, all levers and bellcranks should be level and at 90 degrees. They should also be in the center of their travel range.

degrees and high stick at 8 degrees. Use your radio's pitch-curve setting to achieve these settings. Now move on to the throttle curve (see Figure 2). If you're a beginner, you don't need to set any of the idle-up (stunt) throttle curves. For safety, I suggest that you activate the throttle-hold function and use it as you carry the heli if the engine is running. As you did with the pitch curve, set the stick at its midpoint (half stick), and set the servo arm at 90 degrees to the throttle pushrod. Then center the throttle arm on the carb so it's also at half. Adjust the pushrod as necessary. Now check the endpoints, making sure that they don't bind and stall the servo at the extreme ends of its travel. Use the ATV function—not the endpoints of the throttle curve!—to make any necessary adjustments. Keep the ATV percentages at both ends equal. You will have to adjust the servo or the throttle-arm length and the pushrod to get it just right. Again, the best way to do all of this is to get experienced help.

FIRST FLIGHTS

Enough of all this setup stuff! Let's hover! First, you'll need some type of training gear. You can make a simple set quickly and easily. See "Getting Started in Helicopters," *Model Airplane News*, November '98, or follow your instructor's recommendations. If at all possible, have an experienced heli pilot do the first flights; he will be able to make the necessary trim adjustments to achieve a stable hover.

If you must go it alone, here are some suggestions:

• Check the blade tracking to ensure that both blades are "flying" in the same plane. Power up the rotor so that it's close to—but not at—liftoff. From the rear, look at the edge of the rotor disk as it turns. It will be obvious if one blade tracks higher than the other. Make any tracking adjustments to the slave blade so you won't inadvertently change the pitch-curve settings.

• When the tracking is correct, check the tail-rotor trim. As the heli becomes light on its skids (starts to lift off), it may yaw in one direction; if this happens, you'll need to change the trim. If the tail rotor was set up according to the manual, you wouldn't have to change the trim. I recommend that you make trim changes to the linkage and keep the trim lever on the transmitter centered (all initial trim changes should be made this way).

• Before you start to hover, choose a "home" position that's 10 to 15 feet behind and slightly to one side of the heli; this will help you to match your transmitter inputs to the heli's reaction. One important note: always fly the *nose* of the heli, not the tail. In other words, if you give a left tail-rotor command, the nose should go to the left, just as if you were sitting in the heli.

• Slowly bring the power up until the heli gets light on its skids. If it starts to hover, bring the throttle down a little until the heli is almost hovering. For now, the lack of altitude is your friend.

• Starting with the tail rotor, begin to move the controls. Move the heli to the left and to the right. If its main rotor rotates clockwise, notice that as you move the tail rotor to the right, the heli tries to lift. This occurs because the tail-rotor pitch decreases, so less power is needed. The opposite happens with left tail rotor.

• Now move the cyclic controls one at a time. Apply a little right cyclic, and the heli should slowly slide to the right; left cyclic, and it should slide to the left. Avoid moving the heli backward until you have more experience, as its vertical fin could catch on the ground and tip the heli over.

• By now, I'm sure you've noticed that the heli tends to slide all over the place. Because it is in ground effect, it will not remain stationary. Your job is to try to keep the model close to your starting point. At this point, don't worry about keeping it in one spot; that will come with experience. Just keep it very low, and get familiar with the controls. Try this for a few tanks of fuel until you can keep the heli closer to the point at which it started.

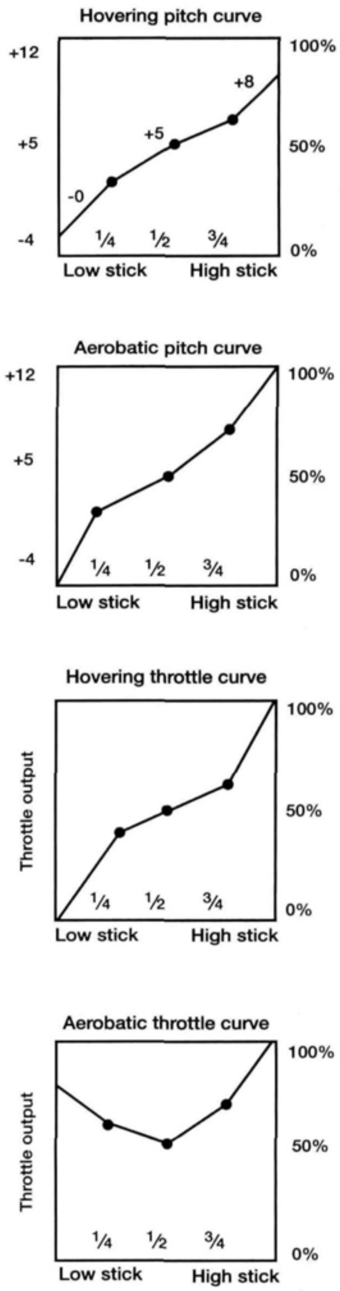


Figure 2. Typical pitch and throttle curves. Notice that the pitch curves are almost the same; the difference is the amount of pitch and low and high stick. Also notice the power requirements for the aerobatic throttle curve.

That's all for now; keep practicing as described, and next time, we'll start some ground exercises. Until next time, fly safely and with purpose.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

 by George Leu

Documentation sources

I spend a lot of time searching for scale documentation. When I travel, I spend my spare time in bookstores and museums looking for material. On a recent West Coast business trip, I purchased "Luftwaffe Fighter Aircraft in Profile," by Claes Sundin and Christer Bergstrom, at an airport bookstore. The text and color profiles in this book are excellent, and it's printed on high-quality paper.

The book is from Schiffer Publishing* in Atglen, PA. This 25-year-old firm specializes in military history books; it publishes about 250 new books each year, many about specific military subjects and history.

Recently, Schiffer created a retail website to provide more current information about upcoming releases to its readers, and to allow them to purchase directly. If you're looking for military documentation, I recommend that you write to them or check their website at www.schifferbooks.com. If you want to develop your military library, Schiffer is a good place to start.

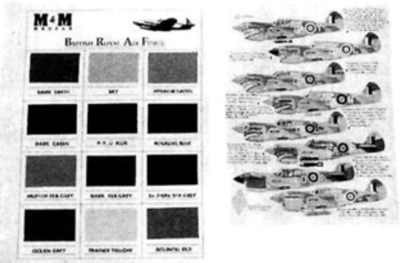
KEEP IT SIMPLE!

I have received a number of letters recently asking for help with documentation. I think that scale modelers tend to greatly over-prepare their documentation, so my best suggestion is to use the KISS approach when putting together a documentation booklet. Also, read the scale section of the AMA rule book. Outline, color and markings, and craftsmanship make up the three parts of static judging. Outline and color and markings are the major ingredients for your documentation booklet. It's important to remember that craftsmanship is judged by your model's overall building quality while outline and color and markings are judged by what you show of the full-size aircraft.

Schiffer Books are an excellent source for scale documentation. These aviation-specific books are illustrated with beautiful color drawings and close-up, detailed photography.

Present your documentation simply and neatly in a three-ring notebook (the kind that allows the pages to be removed, if necessary). Your notebook should be divided into two sections clearly labeled "Outline" and "Color and Markings." A 3-view drawing from a reputable source such as Scale Model Research*, Squadron/Signal Publications*, or from a magazine is allowed for your proof of outline. Put it in a plastic cover, insert it in the "Outline" section of your booklet, and you're finished.

The "Color and Markings" section is where you show proof of your aircraft's paint scheme. If you used a color drawing or photograph of your aircraft and you painted your model to match it, use either one for your color and markings documentation. Because color drawings and photographs can inaccurately reproduce the correct colors for you to match, your presentation will be better if you use the picture or drawing for proof of markings and paint chips for proof of your model's color. You can put the paint chips on another page of your documentation.



Paint chips and color drawings of subject aircraft offer an excellent way to improve your documentation package.

You have now finished with all the information required to document your particular aircraft. Add an introductory page explaining how your model aircraft originated (kit, plans, scratch-built, etc.), mention any special items you made, and provide a statement that says you are the builder of the model. A proper documentation presentation consists of three or four pages. Remember: do not show photos that point out mistakes in your model! If you have a photo of the full-size tailwheel and your model's tailwheel does not match it, don't include that photo; show only what will help your score. In documentation, less is definitely more!

The Century Jet Models F-4 Phantom jet fighter is an impressive model. The newly redesigned F-4 can be powered by either turbine or ducted fan.

CJM PHANTOM

If you like jets, then you probably love the F-4 Phantom. If you've ever flown ducted-fan F-4s, you know how well they behave in the air. Century Jet Models (CJM)* has introduced an updated version of its big Phantom, and I think it is positively awesome.

The upgrades to the kit include a primed fiberglass fuselage with panel lines available in either the "D" or "E" configuration, factory-sheeted main and outer wing panels, a plug-in wing design with strengthened landing-gear blocks, scale intakes, fiberglass stabs and rudder and a host of other refinements. Even the new landing gear simulate the full-size strut action. The kit is available for turbine or ducted-fan power.

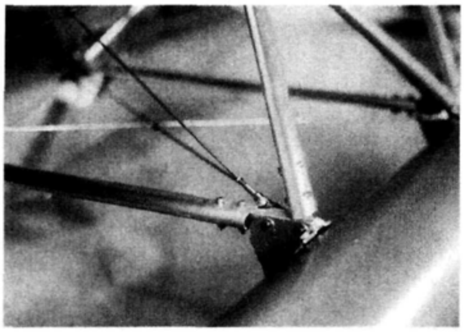
CJM wants to be known as the company that makes the best Phantom kit on the market, and I think it just might be.

NEW STUFF

Dave Reid of Reid's Quality Model Products* has just released a set of plans for a 1/5-scale Ercoupe ($24.95 plus shipping). This twin-tail, civilian classic has a 72-inch span with about 870 square inches of wing area and is intended for 1.20 to 1.50 2-stroke or 4-stroke engines. The Ercoupe is of all-wood construction, and a fiberglass cowl is available from

Attached to this Super Cub, Sea Commander Floats easily turn it into a seaplane.

Reid's Quality Model Products has introduced a new plan set for the classic Ercoupe; it's intended for 1.20 to 1.50 engines.



Sea Commander Floats are strongly built and true to scale.

Dave for $31.95 plus shipping.

When I attended the Great Northwest Hobby Expo in Puyallup, WA, earlier this year, I ran into Gordon and Linda Kolke of Sea Commander Floats*. What impresses me about Sea Commander floats is their very scale appearance and the way they're built. These high-quality, fiberglass floats are available in a variety of sizes, from about .40 to giant scale. Internal hard points are molded in, and the attachment struts are made of streamlined metal tubes, just as on the real thing. The finished product would look great on any model (sport or scale) you'd like to have floating around. Now, let's see: where did I leave that ¼-scale Cub?

Gordon and Linda Kolke show their floats at the Great Northwest Hobby Expo.

SIMPLE INSTRUMENT PANELS

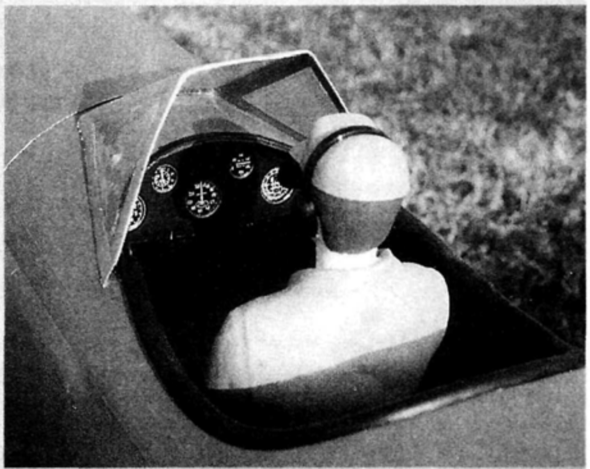
Custom-made instrument panels are available from many sources these days, and you can get commercially available masterpieces that drop right into place to instantly dress up your cockpit. However, not every plane requires a super-detailed, custom dashboard, and if you want to make your own, here's a simple method.

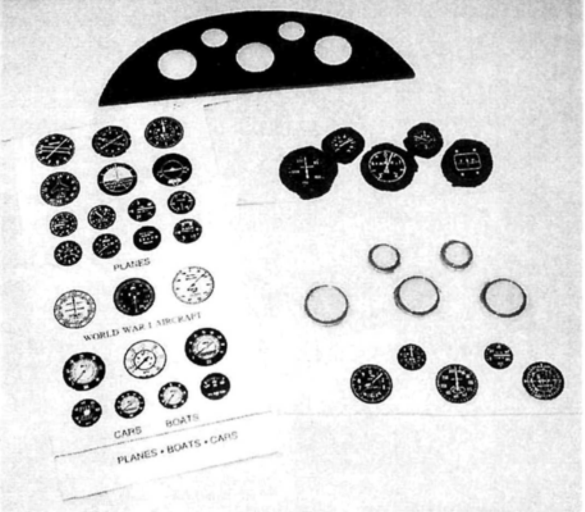
I use the instrument kit from JP Products* for this technique; it has several styles of gauges to choose from. Start by cutting out your desired instruments and setting them aside. Trim the clear plastic faces to whichever size will cover them. Cut the instrument panel from 1⁄16-inch or ⅛-inch plywood, and trim it to fit into your cockpit; there's usually a bulkhead in the front of the cockpit that you can use as a shape guide. When you are satisfied with the panel, trace its shape onto a piece of cardboard or file-folder stock and paint it black.

When the paint has dried, position the paper instruments on the plywood dashboard and mark their locations with a pencil. Now use a Forstner bit to drill out the instrument holes in your dashboard. Touch up the edges of the holes with paint, and the panel is finished.

Transfer the hole locations to the cardboard and glue the paper instruments to the cardboard with PFM* or Pacer's* Zap-a-Dap-a-Goo. While it is drying, glue the plastic faces into the openings in the panel.

The final step is to bond the dashboard to the cardboard template with the instrument faces aligned with the panel openings. Be sure not to get any adhesive on the instruments, and use weights to hold the instrument-panel parts together flat and straight while the glue dries overnight. The next day, you should have a good-looking, basic instrument panel to install in your aircraft. Give it a try.





Simple instrument panels can quickly dress up your model. Many panel kits are available, and making a panel is easier than you think.

**Addresses are listed alphabetically in the Index of Manufacturers on page 142.*

PRODUCT WATCH

Editors' picks of the month

AT MODEL AIRPLANE NEWS, we not only tell you what's new, but we try it out first to bring you mini-reviews of the stuff we like best. We're constantly being sent the latest support equipment manufacturers have to offer. If we think a product is good—something special that will make your modeling experiences a little easier or just plain more fun—we'll let you know here. From retracts and hinges to glow starters and videotapes, look for it in "Product Watch."

EXPERT ELECTRONICS

V-300 Voltmeter

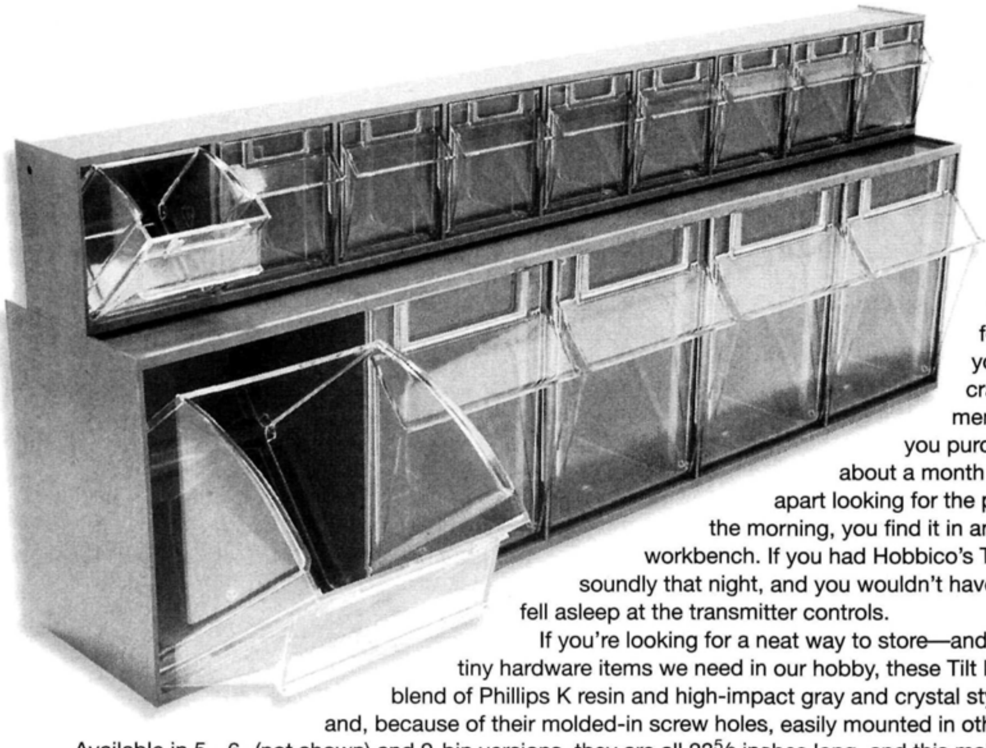
Bargain Battery Checker

Few items in your flight box are as important as a good-quality voltmeter. Your model's operation depends on the proper allocation of voltage for servo movement and radio operation. You knew that, but you'd be amazed at how often I've seen people fly for a good part of the day and then risk one last flight without checking their airborne packs. Simply monitoring voltage is not sufficient; you must place the batteries under a load great enough to simulate flight conditions. To help you obtain an accurate reading, Expert Electronics offers a great-looking and highly functional meter that's designed for 4.8 and 6V operation. This rugged metal meter is connected via a 2-foot-long universal cord and places your system under a 300mAh load. Ten high-resolution LEDs display voltage in percentages. The solid-state unit requires no calibration, and it is accurate to within 0.04 volt for a 4-cell pack and 0.05 volt for a 5-cell pack. A handy reference chart on the back of the meter further explains the lights' indications. The V-300 works well, carries a 2-year warranty and retails for less than 16 bucks; in my book, that's cheap insurance.

—Bob Hastings

Price—$15.95.

Expert Electronics; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61822; (217) 355-9511; website: www.horizonhobby.com.



HOBBICO

Tilt Bins

A Place for Everything ...

Has this ever happened to you? It's 11:52 on a Saturday night, and you've just put the finishing touches on the new biplane project you've been telling your flying buddies about for months. You do a final assembly but to your horror, you find that you're one 2-56 aircraft nut short for the interplane strut attachment. But wait!! You suddenly remember that you purchased a whole package of these very nuts about a month ago. Frantically, you tear your workshop apart looking for the package of nuts until at last, around 3:30 in the morning, you find it in an old, dust-covered kit box shoved under the workbench. If you had Hobbico's Tilt Bins in your shop, you would have slept soundly that night, and you wouldn't have crashed your beautiful bipe because you fell asleep at the transmitter controls.

If you're looking for a neat way to store—and quickly find—the seemingly endless array of tiny hardware items we need in our hobby, these Tilt Bins are the answer. Made from a custom blend of Phillips K resin and high-impact gray and crystal styrene housing, they're durable, lightweight and, because of their molded-in screw holes, easily mounted in otherwise unused areas in a workshop. Available in 5-, 6- (not shown) and 9-bin versions, they are all 23⅝ inches long, and this makes them conveniently stackable. The tilt-out bins are removable for filling or cleaning and have built-in label slots so you can list each bin's contents.

My friends will tell you that I'm not the most organized person in the world, but my shop is much more enjoyable to work in since I equipped it with these Hobbico bins.

Part nos.—BUKR0105 (5-compartment), BUKR0106 (6-compartment), BUKR0109 (9-compartment); prices—$27.99; $17.99; $13.99.

—Chris Chiannelli

BOB SMITH INDUSTRIES

IC-2000

A Sticky Situation

When you see Bob Smith Industries' newest adhesive, IC-2000, you'll know immediately that something about it is different: it's black! That's because it has been "rubber toughened." Why is this a good thing? Well, think of the nice, soft soles of your sneakers or the grommets with which you mount your servos; the rubber provides your model with shock absorption. Now your glue joints can have the strength of CA with added flexibility.

Model Airplane News gave me the chance to really put this new black glue to the test during an R/C combat session at the Kingston, Ontario, Father's Day Fun-Fly. Shortly after our combat session began, somebody mistook my wing for a streamer and cut the left panel in half. The rubberized glue worked well to fill in gaps and attach unlike parts to one another (balsa, plywood, plastic—even the covering!). The glue's set-up time—around 30 seconds—was sufficient to accurately align the parts that needed to be repaired. The items we fixed did not break in the next combat mission "incident," though others did! I am sure every modeler will find a use for this new product (as in: don't leave home without it).

—Dan Luchaco

Part no.—BSI-118; price—$7.99.
Bob Smith Industries, 8060 Morro Rd., Atascadero, CA 93422; (800) 223-7699; fax (805) 466-1717.

CLARK INDUSTRIES

Propellers

Prop Dept.

Our north-of-the-border friends at Clark Industries are well known for their extensive line of propellers. Proprietor John Clark produces many beautiful WW I scale props as well as a select line of standard sportsman props. The standard props are available in solid hard birch as well as laminated hardwood in sizes ranging from 12x6 to 28x14 (note: 20x20 props are available laminated only).

The WW I props come in solid hardwood or in beautifully laminated birch and cherry and are available in 17- to 20-inch diameters. A special-order laminated, 26-inch, 1/3-scale Sopwith Pup prop is also available, and Clark Industries manufactures props for the Proctor Enterprises Nieuport, Albatross, Jenny and Fokker Dr.1 kits, too.

I ran a few of Clark Industries' props and found them to be very stiff and well balanced; they required only a slight sanding to bring them into perfect balance on my HiPoint balancer. The props come without a clear finish and can be used "as is" or sprayed with a quick coat of polyurethane. I used Red Devil spray spar varnish with excellent results. Looking for decorating ideas? Clark Industries also offers wall-mounted propeller clocks in 26-, 60- and 100-inch diameters.

—Gerry Yarrish

Clark Industries, Biggin Hill, R.R. #4, Tottenham, Ontario, Canada L0G 1W0; (905) 936-2131.

SLIMLINE MFG.

Boxer Fuel Pump

Lean and Mean

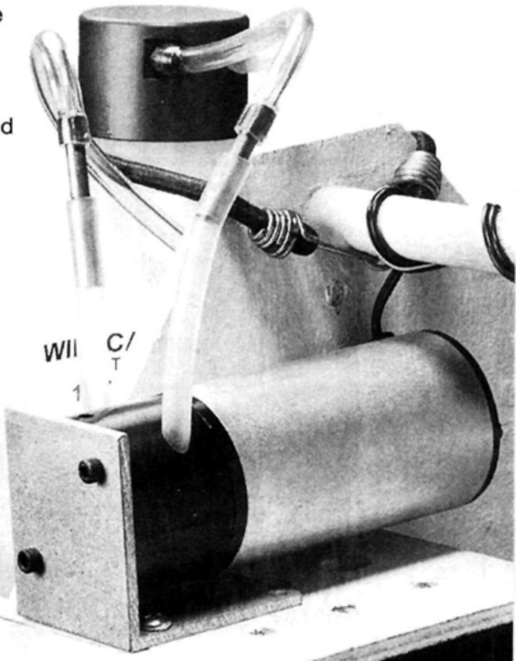
Slimline Mfg., well known for its custom mufflers, has ventured away from in front of the firewall and toward our field boxes by way of its new electric fuel pump that consists of a self-contained pump body, a screw-on fuel bottle cap and a sturdy pump mount bracket. Designed to be permanently mounted to your field box, the Slimline pump takes only minutes to install. The anodized fuel bottle cap comes with an O-ring seal and large brass attachment nipples to make the plumbing connections a piece of cake.

The power lead is long enough to reach your power panel, but you'll need to supply your own power attachment clips. To keep the wiring neat, I wrapped the power lead around my field box's carrying handle.

In operation, the pump uses large-diameter fuel line and takes approximately 1 minute to fill a 10-ounce tank. Its rugged construction promises long service life and is available for glow fuel only. The Slimline fuel pump is definitely worth your consideration.

—Gerry Yarrish

Price—$34.99.
Slimline Mfg., P.O. Box 3295, Scottsdale, AZ 85271-3295; (602) 967-5053.



**The addresses of the companies featured here are listed alphabetically in the Index of Manufacturers on page 142.*

Manufacturers! To have your products featured here, send them to **Model Airplane News,** attention: Product Watch, Air Age Inc., 100 East Ridge, Ridgefield, CT 06877-4606 USA.

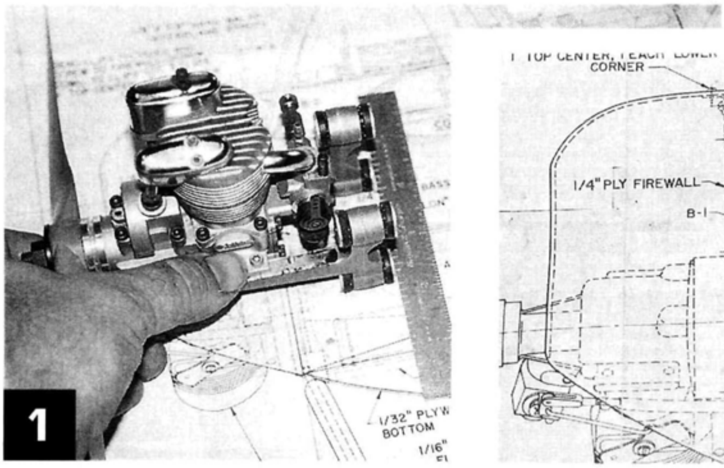
MODEL AIRPLANE NEWS
HOW TO

Make a Recessed Engine Firewall

A removable solution to a tight situation

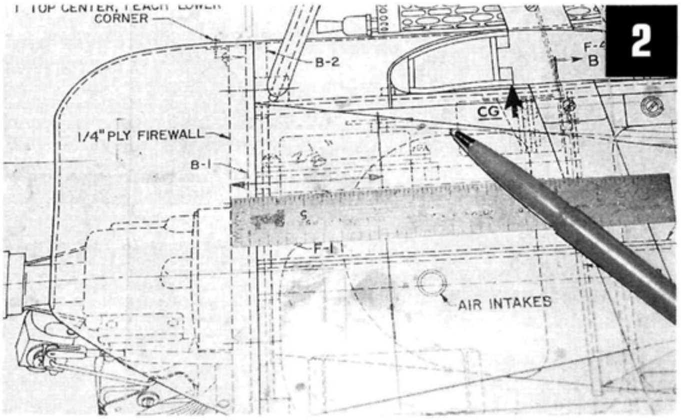
by GERRY YARRISH

How can you fit a 5-inch-long engine into a 3-inch cowl? Leaving 2 inches of the engine sticking out at the front looks silly, and extending the cowl often alters a model's scale outline—not good for competition. The answer is to make a recessed firewall. I've used this recessed firewall design for a while, and I think it works very well. I take a few simple measurements, and my prop and thrust washer always end up where they belong, and my models' scale outlines remain. I also make my firewalls removable to ease maintenance. I attach the fuel tank and the throttle servo to the back of the firewall to simplify installation and keep most of the weight forward (particularly important for scale biplanes and triplanes). Here's how to do it:



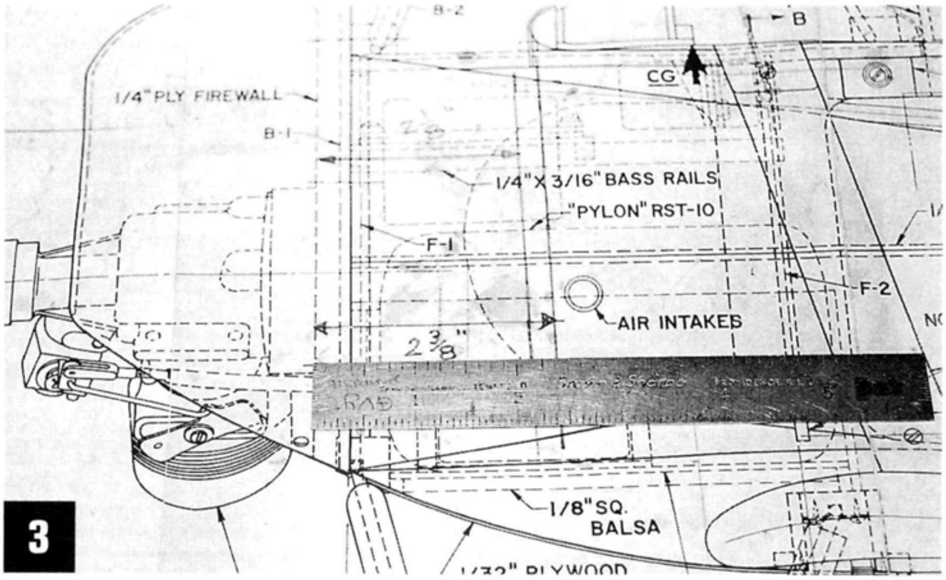
1

You'll need some ¼-inch-thick plywood, a scroll saw or a coping saw, screws and epoxy. Attach the engine (Saito .56 shown) to its mount and lay them on the side view of your model's plan (here, a VK Fokker triplane). To determine how deeply your firewall should be recessed, mark the position of the engine mount's rear surface on the plans.



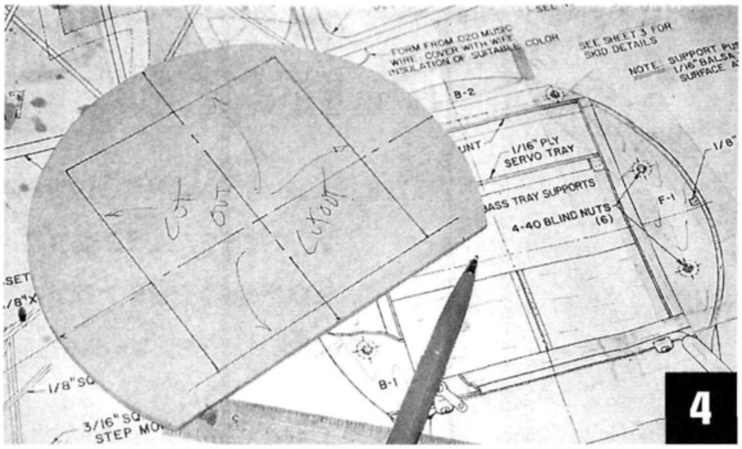
2

In this case, the distance between the main firewall's face and the rear surface of the engine mount is 2⅛ inches. On the plan, draw a vertical line there (arrowed).

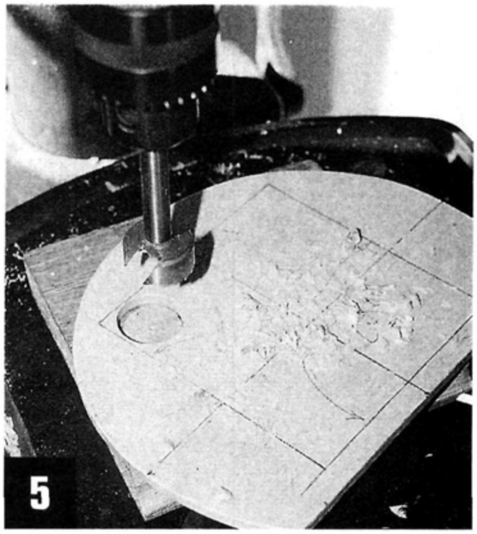


3

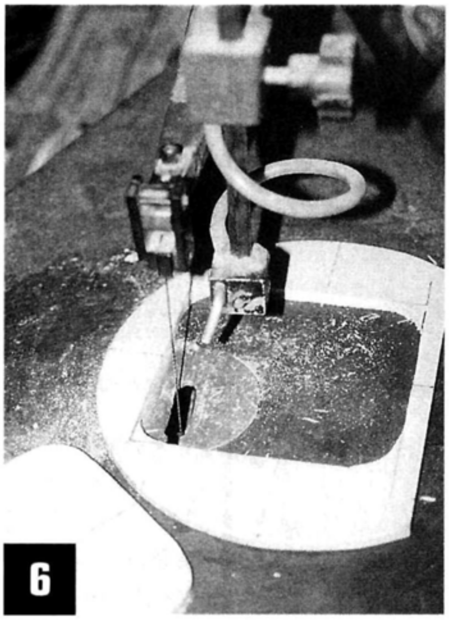
Now draw a second vertical line aft of the first line. This line should be the thickness of your secondary firewall aft of the first line; here, 2⅜ inches from the firewall face—for a ¼ inch-thick secondary firewall. This is also the depth of the recessed firewall box structure.



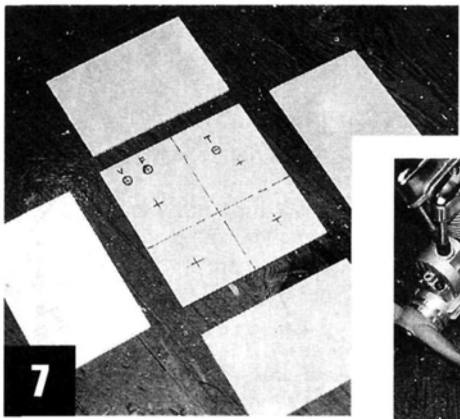
Establish your firewalls' centerlines, and then mark the outline of the recess. I usually make it about ¼ inch smaller all around than the fuselage's inner structure.



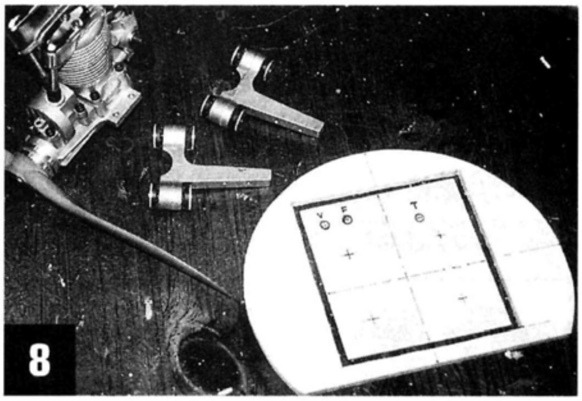
Use a Forstner bit or a large drill bit, and drill a hole in the inner corner of the main firewall opening. This will allow a saw blade to pass through the firewall when you cut out the rest of the opening.



Use a scroll saw to finish the job of cutting out the firewall recess area. Make the corner cuts square, then lightly sand their inner edges flat and smooth.

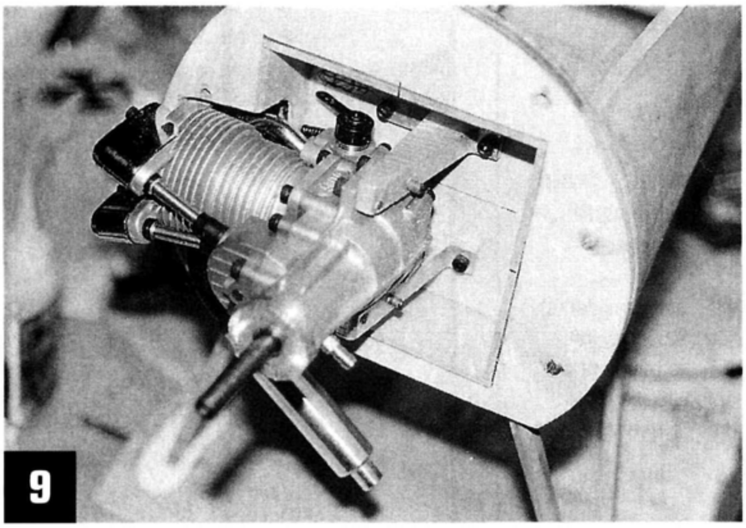


Cut the four walls of the recessed box out of ⅛-inch ply, and make the secondary firewall of ¼-inch ply. The walls are wide enough to fit snugly around the opening in the main firewall, and the secondary firewall (to which the engine mounts are attached) should fit snugly within the walls.

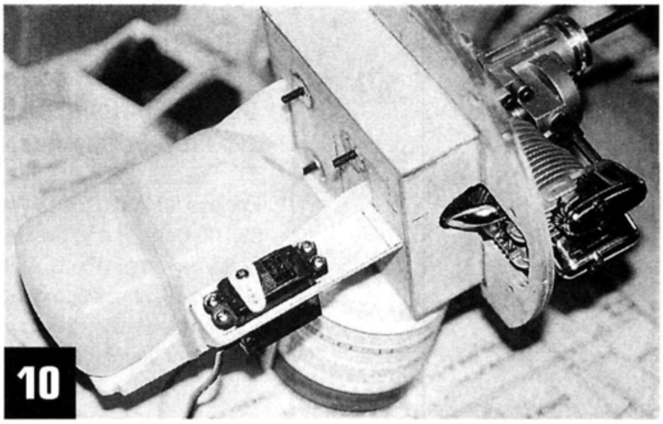


The centerlines of the main and secondary firewalls should line up with each other. Now drill fuel-line and vent-line holes and holes for the throttle-linkage and the engine-mount attachment.

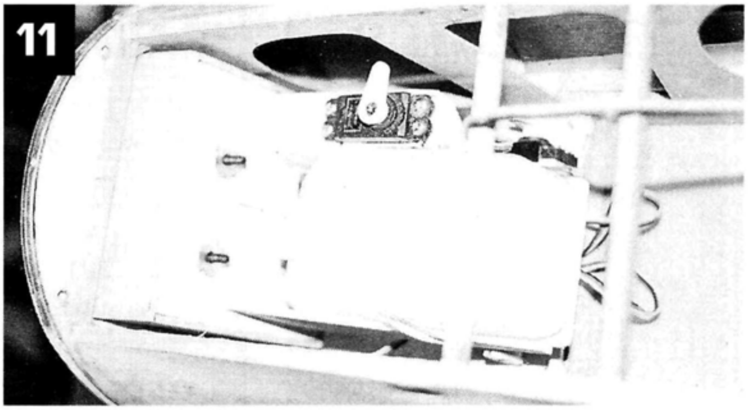
Epoxy the four walls to the secondary firewall to form a box, and when the epoxy has cured, fit the box into the opening in the main firewall (keep the edges of the walls flush with the main firewall face) and epoxy it into place.



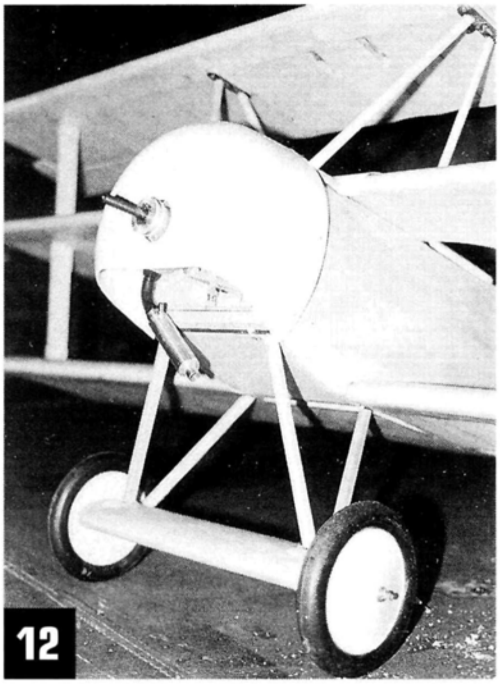
The engine has been installed, and the main firewall has been screwed to the fuselage. Blind nuts in the fuselage match the six screws that hold the firewall in place.



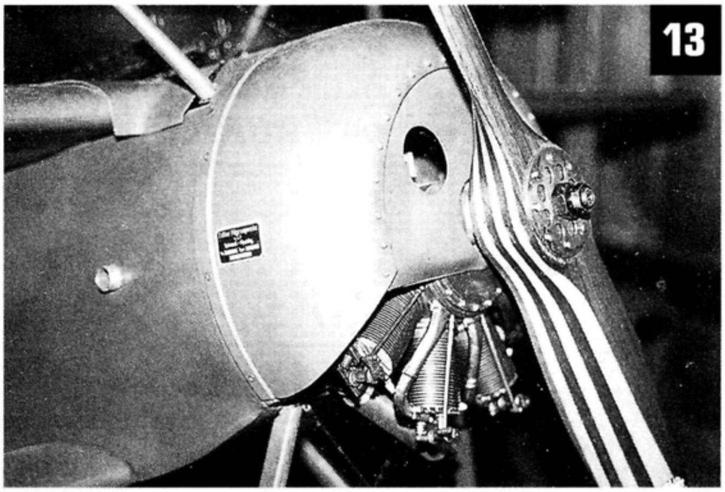
To the back of the secondary firewall, epoxy a lite-ply shelf that will hold the fuel tank and the throttle servo. Note that some of the main firewall must be removed to allow clearance for the cylinder head and the intake manifold.



This view from above shows how nicely the tank and throttle servo fit inside the fuselage.



Attach the engine cowl, adjust it so that the engine fits properly through the center cutout, and then screw the aft edge of the cowl to the fuselage. Finish detailing the cowl, and you're ready to paint.



The finished engine cowl is dressed up with a removable dummy radial engine. The Saito muffler is barely visible, and the engine is completely hidden. ✦

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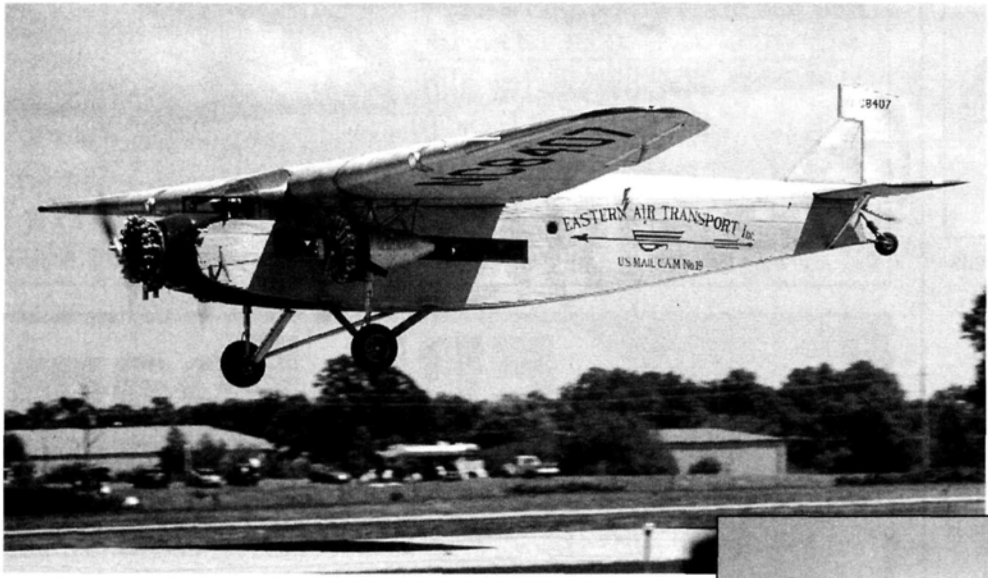

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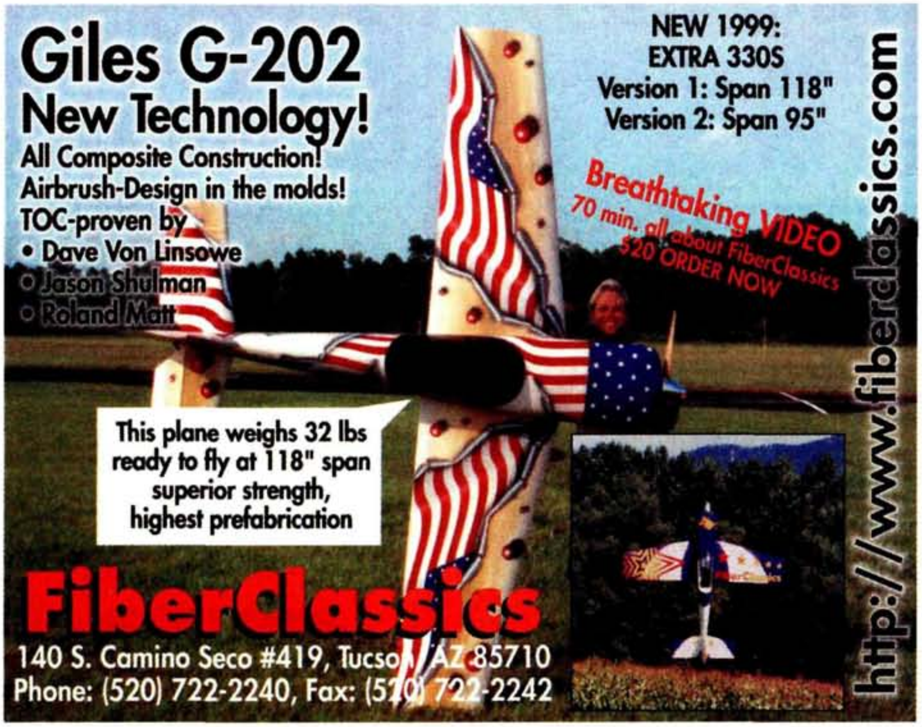

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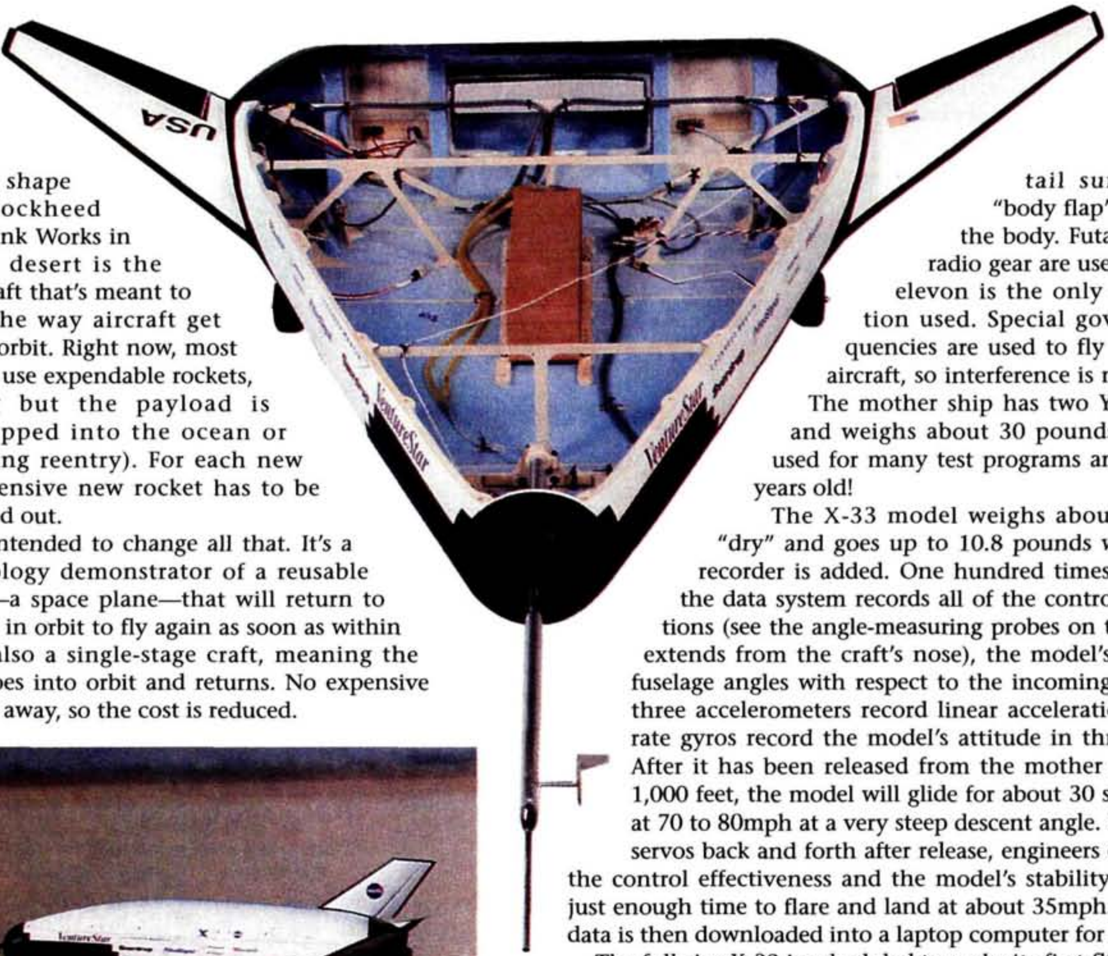
FINAL APPROACH

BY DON EDBERG

X-33—space shuttle of the future?



Now taking shape at the Lockheed Martin Skunk Works in the California desert is the X-33—a spacecraft that's meant to revolutionize the way aircraft get into and out of orbit. Right now, most orbital launches use expendable rockets, so everything but the payload is discarded (dropped into the ocean or burned up during reentry). For each new launch, an expensive new rocket has to be built and checked out.

The X-33 is intended to change all that. It's a $\frac{1}{2}$-scale technology demonstrator of a reusable launch vehicle—a space plane—that will return to earth after being in orbit to fly again as soon as within one week. It's also a single-stage craft, meaning the entire vehicle goes into orbit and returns. No expensive parts are thrown away, so the cost is reduced.

So what does this have to do with model airplanes? Well, the X-33 will glide down to Earth to land horizontally on a runway after it orbits, but *it has no wings!* The X-33's roundish shape is called a "lifting body."

NASA decided to use a scale model to gather data on some aspects of the X-33 and its flight characteristics. NASA engineers Dale Reed and Alex Sim worked with R/C pilot Tony Frackowiak to design, build and pilot a $\frac{1}{17}$-scale model of the real thing. This scale was dictated by the size of the R/C mother ship that would drop the X-33 model from altitude! The model doesn't have rocket power.

The model is carved out of blue foam and has plywood bulkheads for structural strength. It is entirely covered with 2-ounce fiberglass for durability. The tails are white foam covered with balsa. The only flight controls are two rudders (on the verticals), two elevons on the canted tail surfaces and a "body flap" at the rear of the body. Futaba servos and radio gear are used throughout; elevon is the only mixing function used. Special government frequencies are used to fly both of these aircraft, so interference is not a problem.

The mother ship has two YS .91 engines and weighs about 30 pounds. It has been used for many test programs and is about 30 years old!

The X-33 model weighs about 7.5 pounds "dry" and goes up to 10.8 pounds when the data recorder is added. One hundred times each second, the data system records all of the control-surface positions (see the angle-measuring probes on the boom that extends from the craft's nose), the model's airspeed and fuselage angles with respect to the incoming air direction; three accelerometers record linear accelerations and three rate gyros record the model's attitude in three directions. After it has been released from the mother ship at about 1,000 feet, the model will glide for about 30 seconds, flying at 70 to 80mph at a very steep descent angle. By pulsing the servos back and forth after release, engineers can determine the control effectiveness and the model's stability. Then there's just enough time to flare and land at about 35mph. The recorded data is then downloaded into a laptop computer for analysis.

The full-size X-33 is scheduled to make its first flight sometime next year from Edwards Air Force Base and should accelerate to as fast as Mach 13.8, climb as high as 250,000 feet and land in Utah or Montana, depending on the test flight's profile.